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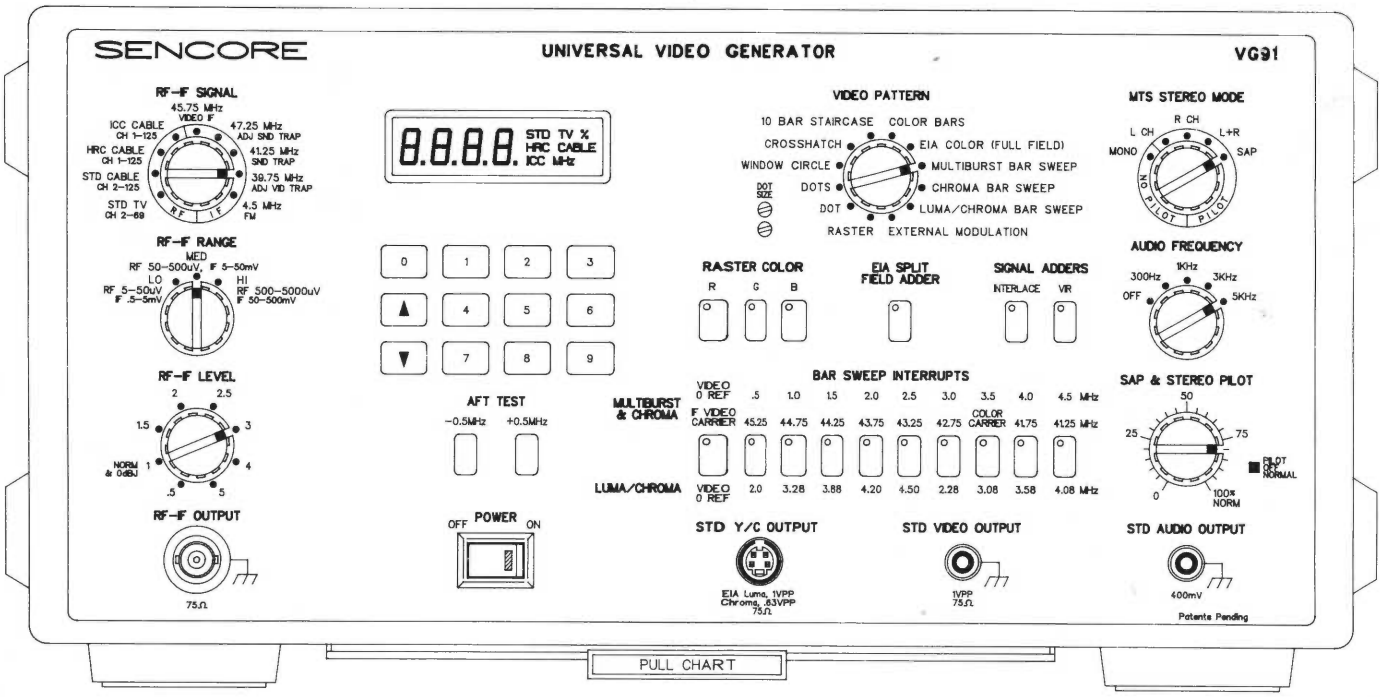
VG91

Universal Video Generator

Operation and Application Manual



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3200 Sencore Drive, Sioux Falls, South Dakota 57107

WARNING

PLEASE OBSERVE THESE SAFETY PRECAUTIONS

There is always a danger present when testing electronic equipment. Unexpected high voltages can be present at unusual locations in defective equipment. Become familiar with the equipment you're working with, and observe the following safety precautions.

Every precaution has been taken in the design of your instrument to insure that it is as safe as possible. **However, safe operation depends on you, the operator.**

1. Never exceed the limits of this instrument as given in the specifications section and the additional special warnings in this manual.

2. A severe shock hazard can result if the chassis of the equipment being serviced is tied to the "hot" side of the AC line. An isolation transformer should always be used with hot-chassis equipment. Also, be sure that the top of your workbench and the floor underneath it are dry and made of non-conductive materials.

3. Remove the circuit power before making connections to high voltage points. If this cannot be done, be sure to avoid contact with other equipment or metal objects. Place one hand in your pocket and stand on an insulated floor to reduce the possibility of shock.

4. Discharge filter capacitors (after removing power) before connecting to any part of the circuit requiring power to be removed.

5. Be sure your equipment is in good order. Broken or frayed test leads can be extremely dangerous and can expose you to dangerous voltages.

6. Remove the test lead immediately after the test has been completed to reduce the possibility of shock.

7. Do not work alone when working on hazardous circuits. Always have another person close by in case of an accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment, or coming in contact with high voltages.

8. Improper Fuse(s) Void Warranty. Fuses are for your protection, so always replace fuse with proper type and current rating. The proper fuse type description is marked near the fuse holder and in the manual.

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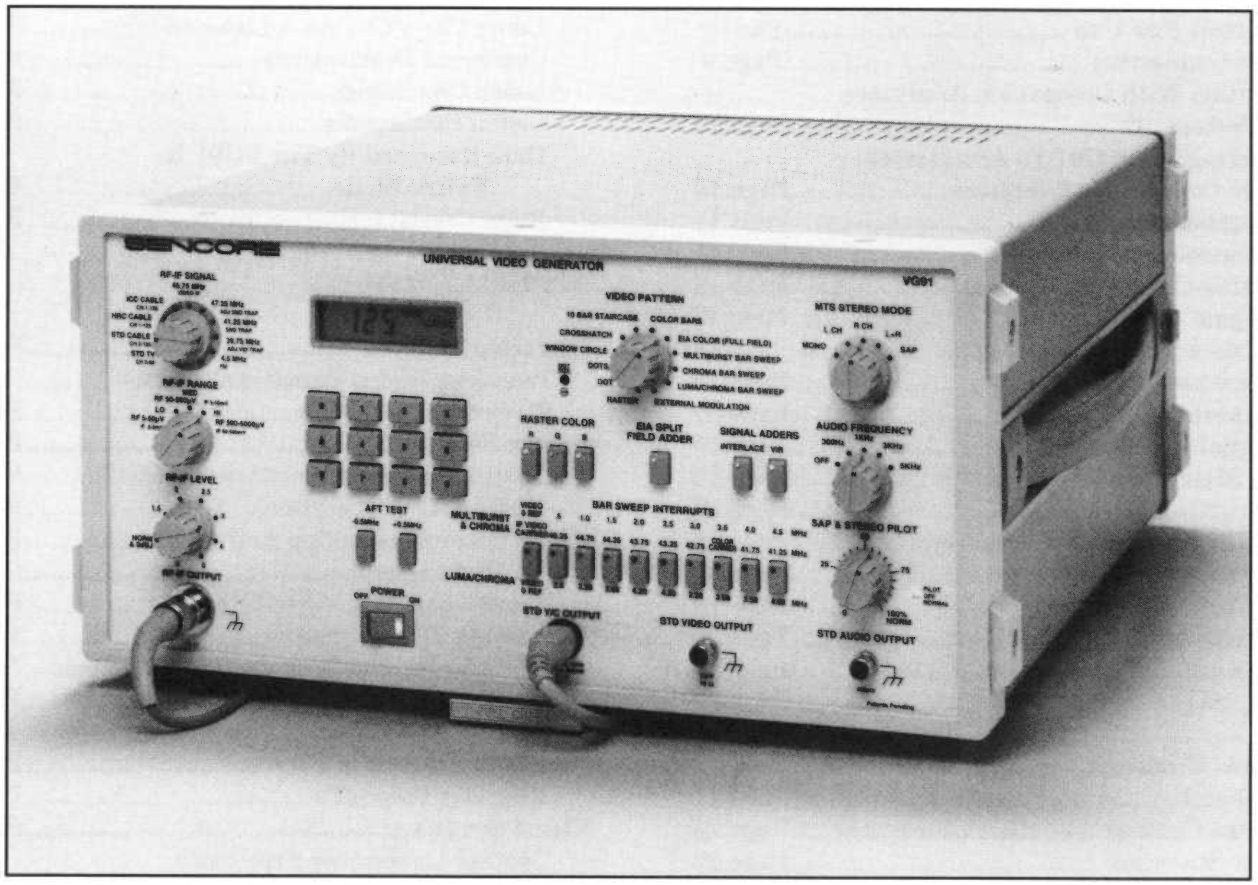

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DESCRIPTION

INTRODUCTION

Video was once considered solely in terms of the household television receiver. Television has grown to become a major and indispensable means of entertainment. But today's video has expanded far beyond the living room. Today NTSC video, in the form of television receivers, video monitors and VCRs, is used extensively in education and industrial applications, as well as in the home entertainment center.

Consumers place great demands on todays video display systems. Projection and large screen direct-view color televisions with features such as improved definition and stereo sound are mainstays in todays high performance video. Higher quality video and audio signals are delivered by broadcasters and cable systems, and the viewer has an ever-increasing number of channels to choose. Video recorders bring far-off places and hi-tech training to the classroom or meeting room, and camcorders that offer near broadcast quality in a palm-sized package allow the consumer to capture a piece of history on video tape.

All of these revolutionary changes offer new opportunities and place growing demands on the technicians who are responsible for servicing and maintaining today's high-tech NTSC TV/video products.

The Sencore VG91 "Universal Video Generator" is an all channel, all pattern, and all purpose NTSC video/MTS audio generator. It provides all the off-air TV and cable channels to verify customer complaints, recreate trouble symptoms, and isolate receiver problems. Each channel is variable in signal level and can be modulated with video patterns and mono or MTS audio. Video IF signals, standard S-Video (YC), composite video, and baseband audio signals are provided to isolate problems to any video component. All of the test signals needed to thoroughly and accurately test, align, and troubleshoot NTSC TV-video systems are provided in one complete, easy-to-use instrument.

The VG91 Universal Video Generator serves as the signal source for the Sencore VC93 "All Format VCR Analyzer" and the TV92 "TV Video Analyzer". Its signals are common to FCC and NTSC specifications to resist obsolescence. As video systems change, the VG91 can be updated with other accessories or companion analyzers to meet the servicing needs of new video systems.

FEATURES

The VG91 produces all of the allocated VHF & UHF off-air TV channels and 125 standard, HRC, or ICC cable designated channels. The TV-RF channels are digitally synthesized and match all off-air and cable channel designated frequencies to test "cable ready" tuners. An RF attenuator provides accurate signal levels to duplicate weak or strong signals.

A crystal accurate 45.75 MHz IF generator provides a modulated IF carrier to substitute for tuners and isolate defects in video-IF circuits. Exclusive trap signals dynamically check adjacent channel rejection and provide fast and accurate trap alignment. A modulated 4.5 MHz audio IF signal is provided for audio troubleshooting. An AFT Test provides a quick performance check of the receiver's AFT circuits to simplify troubleshooting and alignment.

The VG91's NTSC video pattern generator provides standard patterns for performance testing and alignment. An exclusive, patent pending Luma/Chroma Bar Sweep pattern analyzes circuits with extended bandwidths such as comb filters and wideband I color circuits.

An MTS stereo audio generator provides signals to verify the performance of MTS circuits. The MTS signal is available on all RF channels, as well as the 45.75 MHz IF and 4.5 MHz audio IF signals.

Y/C (S-Video), composite video and baseband audio outputs provide signals for testing video and audio circuits through standard input jacks.

The VG91 teams-up with specialized Sencore video analyzers, such as the VC93 "ALL Format VCR Analyzer" or TVA92 "TV Video Analyzer". The team specializes in analyzing and pinpointing defects in specific products such as VCRs or TVs. The VG91 provides the necessary synchronizing signals and video patterns to these and other future Sencore video analyzers.

SPECIFICATIONS

TV-RF Generator:

STD TV: FCC allocated VHF and UHF TV channels 2-69
STD CABLE: Cable VHF, Midband, Superband, Hyperband channels 2-125 (54 - 800 MHz)
HRC CABLE: Cable channels 1-125, ±1.25 MHz carrier shift on all channels and the addition of channel 1 at 73 MHz.
ICC CABLE: Cable channels 1-125, channels 5 and 6 shifted + 2.00 MHz and the addition of channel 1 at 73 MHz
CARRIER FREQUENCY ACCURACY: ± 50 kHz
AFT TEST ACCURACY: Shifts Video Carrier + or - 500 kHz, ±25 kHz
VIDEO MODULATION: AM Negative, Peak white 87.5% ± 5%
AURAL CARRIER: Visual carrier + 4.5 MHz, ± 1 kHz
AURAL CARRIER LEVEL: -17 dB ± 3 dB of Visual Carrier
AURAL MODULATION: ± 25 kHz Mono, < 75 kHz Stereo
AUDIO MODULATING FREQUENCIES: 300 Hz, 1 kHz, 3 kHz, 5 kHz
RF AURAL STEREO SEPARATION: > 25 dB Typically > 30 dB

Video IF Generator::

VIDEO IF FREQUENCY: Video: 45.75 MHz ±10 kHz; Aural: 41.25 MHz
VIDEO MODULATION: Same as RF Generator.
AUDIO MODULATION: Same as RF Generator.
IF TRAP SIGNALS: 47.25 MHz, 41.25 MHz, or 39.75 MHz ±10 kHz selectable, with a modulated 45.75 MHz Video IF carrier at 1000 µV. (U.S Patent # 4,562,469)
IF TRAP SIGNAL MODULATION: 50% AM modulated with tones selected by AUDIO FREQUENCY switch.
IF TRAP SIGNAL LEVEL: .5-500 mV adjustable with RF-IF RANGE and LEVEL controls.
4.5 MHz SOUND IF: 4.5 MHz ± 1 kHz.
4.5 MHz SOUND MODULATION: Same as RF aural carrier of RF Generator.

RF-IF Output:

RF-IF LEVEL STEP ATTENUATOR: RF Output = LO: 5-50µV, MED: 50-500 µV, HI: 500- 5,000 µV.
RF-IF LEVEL VERNIER ACCURACY: RF "NORM" calibrated 1000µV; total error ±3 dB over HI range for all frequencies.
RF-IF RANGE ACCURACY: HI: Vernier spec applies. Med: - 20 dB ±3 dB from vernier spec. LO: -40 dB ±6 dB from vernier spec.
RF-IF OUTPUT IMPEDANCE: 75Ω ± 10%.
RF-IF OUTPUT PROTECTION: 500 V (DC + Peak AC).

Video Pattern-+ Generator:

PATTERNS: 12 Digitally Generated NTSC Video Patterns and External Input.
RASTER: Blank raster only, choice of primary or secondary colors.
DOT: Electrically centered, single white dot.
DOTS: 315 White dots matrixed in 15 horizontal and 21 vertical lines.
WINDOW CIRCLE: Circle inside a box with center cross lines.
CROSSHATCH: 15 horizontal X 21 vertical lines.
10 BAR STAIRCASE: 10 bars in successive level steps from 10 to 100 IRE.
COLOR BARS: 10 gated rainbow color bars, 30° phase shift per bar ±30 degrees, 50 IRE luminance + chroma to 100 IRE ±5 IRE.
EIA COLOR (FULL FIELD): 75% saturated color bars conforming to EIA RS189A specified levels ±2 IRE.
EIA COLOR (SPLIT FIELD ADDED): Same as full field with -I, white, +Q and black added to bottom 25% of screen.
MULTIBURST BAR SWEEP: 10 interrupted bars, Squarewave interrupt frequencies selectable 500 kHz multiples 0 - 4.5 MHz ±100 kHz.
CHROMA BAR SWEEP: 3 chroma bars of 3.08, 3.58, 4.08 MHz ±100 kHz with white raster to each side; 3.58 bar is cyan 75% saturated. Conforms to RS189A.
LUMA/CHROMA BAR SWEEP: 6 luminance(Y) with 4 chroma(C) bars, individually selectable. Y bars squarewave interrupted frequencies 0, 2.0, 3.28, 3.88, and 4.5 MHz ± 100 kHz. C bars at 2.28, 3.08, and 4.08 MHz. 3.58 bar is cyan 75% saturated, conforming to RS189A.
EXTERNAL MODULATION:
Input: BNC jack, 1 VPP (negative sync) 75Ω impedance. Minimum Input: .75 VPP into 75Ω. Frequency Response: 0-4.5 MHz ±10%.
INTERLACE ADDER: Adds interlace signals to all video patterns except External Modulation. Off is non-interlaced.
VIR ADDER: Inserts Vertical Interval Reference (VIR) test signal to line 19 of any pattern except External Modulation.

Specifications continued

Multichannel TV Sound Signal:

AUDIO MODES: Mono, L only, R only, L+R, SAP.
MODULATING FREQUENCIES: 300 Hz, 1 kHz, 3 kHz, & 5 kHz, ± 2 Hz.
STEREO PILOT FREQUENCY: 15,734 Hz ±2 Hz, locked to horizontal sync.
STEREO PILOT DISTORTION: <2% THD.
STEREO PILOT LEVEL: Variable 0-100%; 100% = 5 kHz deviation
STEREO SUBCARRIER FREQUENCY: 31,468 Hz ±4 Hz, phase locked to pilot.
STEREO SUBCARRIER MODULATION: AM double sideband suppressed carrier.
STEREO SUBCARRIER DISTORTION: <2% THD.
STEREO SUBCARRIER PHASE ACCURACY: <2° coincident with Pilot.
STEREO SUBCARRIER RF-IF CARRIER DEVIATION: ±50 kHz at 100% modulation.
SAP CARRIER FREQUENCY: 78,670 ± 10 Hz, phase locked to Pilot.
SAP CARRIER MODULATION: FM.
SAP CARRIER DISTORTION: <3%.
SAP RF-IF CARRIER DEVIATION: ±15 kHz for 100% modulation.
STEREO NOISE REDUCTION: Simulated dbxTM. [dbx is registered trademark of dbx, Inc]

STD Y/C Output:

LEVEL: 1 VPP (Y) luminance ±10% into 75Ω; .63 VPP (C) chroma ±10% into 75Ω (EIA Color Bars Split field pattern).
LUMA & CHROMA SOURCE: Selected by VIDEO PATTERN switch.
FREQUENCY RESPONSE: (Y) Flat Multiburst Bars to 4.5 MHz, ±10%.
OUTPUT IMPEDANCE: 75Ω ±10%.

STD Video Output:

STD VIDEO LEVEL: 1 VPP into 75Ω, negative sync.
VIDEO PATTERNS: Selected by VIDEO PATTERN switch.
FREQUENCY RESPONSE: Multiburst flat to 4.5 MHz, ±10%.
OUTPUT IMPEDANCE: 75Ω, ±10%.

STD Audio Output:

AUDIO SIGNAL: Selected by AUDIO FREQUENCY control.
DISTORTION: <1% THD + noise.
LEVEL: 400 mV ±150 mV into 10 kΩ.
IMPEDANCE: <1 kΩ.
PROTECTION: 150V (DC + Peak AC).

General:

DIGITAL DISPLAY: 4 digit LCD readout of RF channel and IF Frequencies
WARM-UP TIME: 20 minutes
SIZE: 7" X 14" X 16.7" (17.9 X 35.8 X 42.5 cm) HWD
WEIGHT: 18.2 lbs
POWER: 105-125 VAC, 60 Hz, 42 Watts.

All specifications allow for 20 minutes of warmup and are guaranteed at 15-45° C (59-113° F).

ACCESSORIES

Supplied: (1 each)
39G301 RF-IF Test Cable
39B270 S-Video Y/C Cable
39B296 Video Test Cable
39B241:A Audio Test Cable
39A302 RF-IF Troubleshooting Balun
39A161A F-connector to RCA-female Adapter Cable
39A162A F-connector to RCA-male Adaptor Cable

Optional:
39G232 BNC to BNC Cable
39G266 Synchronizing Interconnect Cable
39G72 RF-IF Matching Baln
PC259 Protective Cover
IB72 IEEE Interface Bus Accessory
IB78 RS232 Interface Accessory

Patents Pending.
All specifications subject to change without notice.

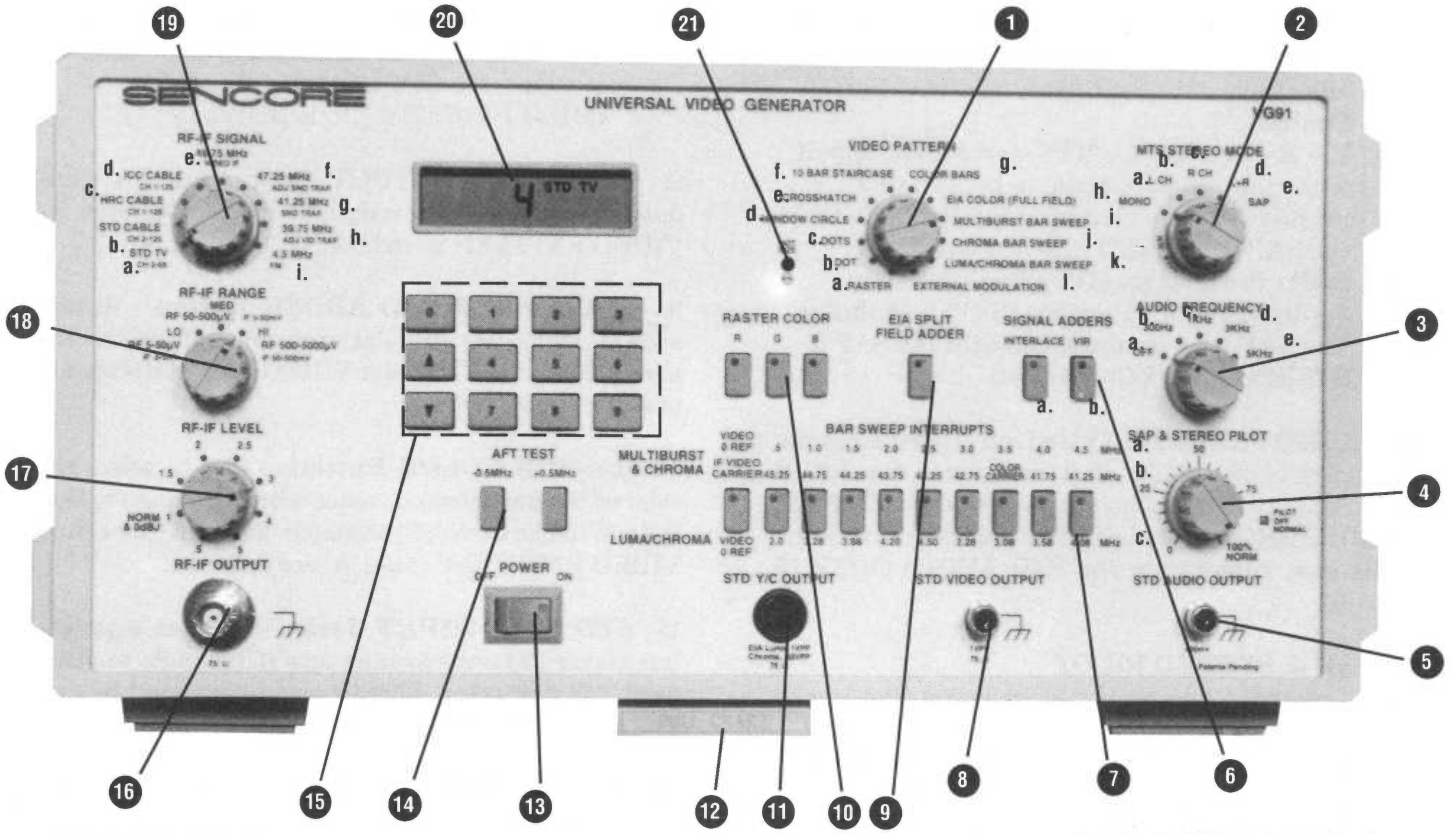


Fig. 1 - VG91 Front Panel Features

CONTROLS

1. **VIDEO PATTERN Switch** - Determines the video modulation of the RF-IF SIGNALs (19), and the video supplied to the STD VIDEO OUTPUT Jack (8), STD Y/C OUTPUT Jack (11), SYNCHRONIZING SIGNAL OUTPUT Jack (22), and 1 VPP OUTPUT Jack (25).
   - a. **RASTER** - Provides a solid raster. Raster color can be changed with RASTER COLOR Switches (10).
   - b. **DOT** - Provides a single dot pattern for setting static convergence.
   - c. **DOTS** - Provides a grid of regulary-spaced dots to test dynamic convergence.
   - d. **WINDOW CIRCLE** - Pattern consists of a circle centered within a box and cross lines for centering and linearity adjustments.
   - e. **CROSSHATCH** - Provides 21 vertical and 15 horizontal lines forming squares for testing size, linearity, and color convergence.
   - f. **10 BAR STAIRCASE** - Provides a 10-step stair case pattern from black to white to test greyscale and video linearity.
   - g. **COLOR BARS** - Provides a sequence of colored bars to test color circuits and display.
   - h. **EIA COLOR FULL FIELD** - Provides standard Full Field color bars.
   - i. **MULTIBURST BAR SWEEP** - Provides 10 groups of luminance multibursts to check IF and video frequency response. The bars are switched on or off with the BAR SWEEP INTERRUPT Switches (7).
   - j. **CHROMA BAR SWEEP** - Provides 3 groups of chroma phased multibursts with a 100% white reference on either side for testing and aligning chroma circuits. The bars are switched on or off with the BAR SWEEP INTERRUPT Switches (7).
   - k. **LUMA/CHROMA BAR SWEEP** - Provides a combination of 6 luminance multibursts and 4 chroma multibursts for checking IF and video response. The bars are switched on or off with the BAR SWEEP INTERRUPT Switches (7).
   - m. **EXTERNAL MODULATION** - Allows external video modulation to be applied to the EXTERNAL MOD INPUT Jack (23).

2. **MTS STEREO MODE Switch** - Determines the audio modulation of the RF-IF SIGNALs (19) and the audio mode supplied to the STD SYNCHRONIZING SIGNAL OUTPUT Jack (22). The frequency is selected by the AUDIO FREQUENCY Switch (3).
   - a. **MONO** - Provides a monaural audio signal with no pilot signal.
   - b. **L CH** - Provides an MTS signal that has left channel modulation only. The pilot level is adustable with the SAP & STEREO PILOT Control (4).

c. **R CH** - Provdies an MTS signal that has right channel modulation only. The pilot level is adjustable with the SAP & STEREO PILOT Control.
d. **L + R** - Provides an MTS stereo audio signal with right channel equal to left channel modulation. The pilot level is adjustable with the SAP & STEREO PILOT Control (4).
e. **SAP** - Provides an MTS signal that has Secondary Audio Program (SAP) modulation. The SAP level is adjustable with the SAP & STEREO PILOT Control (4).

3. **AUDIO FREQUENCY Switch** - Determines the frequency of the audio that modulates the RF-IF SIGNALS (19), the audio supplied to the STD SYNCHRONIZING SIGNAL OUTPUT Jack (22), and the audio tone supplied to the STD AUDIO OUTPUT Jack (5).

4. **SAP & STEREO PILOT**
a. **Control** - Adjusts the MTS stereo pilot level when positions (b-d) of the MTS STEREO MODE Switch (2) are selected. Adjusts the MTS SAP level when position 2e is selected.
b. **PILOT OFF NORM Indicator** - Led lights when SAP & STEREO PILOT Control (4) is set to less than normal (100%) deviation.

5. **STD AUDIO OUTPUT Jack** - Provides standard audio output. Frequency is determined by AUDIO FREQUENCY Switch (3).

6. **SIGNAL ADDERS Buttons** - Use to add signals to the vertical blanking interval of any of the internal patterns selected by the VIDEO PATTERN Switch (1a-k).
a. **INTERLACE** - The video is interlaced when the LED is lit.
b. **VIR** - A Vertical Interval Reference (VIR) signal is added when the LED is lit.

7. **BAR SWEEP INTERRUPTS Buttons** - Switches allow individual bars of the Chroma Bar Sweep, Multiburst Bar Sweep, and Luma/Chroma Bar Sweep VIDEO PATTERNS (1i-k) to be turned on or off.
a. This row of numbers indicates the baseband video frequency (in MHz) of the corresponding bar when the Multiburst or Chroma Bar Sweep VIDEO PATTERN (1i,j) is selected.
b. This row of numbers indicates the IF frequency (in MHz) of the corresponding bar when the Multiburst or Chroma Bar Sweep VIDEO PATTERN (1i, 1j) is selected.
c. This row of numbers indicates the baseband video frequency (in MHz) of the corresponding bar when the Luma/Chroma Bar Sweep VIDEO PATTERN (1k) is selected.

8. **STD VIDEO OUTPUT Jack** - Provides standard composite video output. Video is selected by VIDEO PATTERN switch (1).

9. **EIA SPLIT FIELD ADDER Button** - Switch adds -I, white, +Q and black reference signals to the lower 25% of the EIA Color VIDEO PATTERN switch position (1h).

10. **RASTER COLOR Buttons** - Use to select the color of the background raster when the Raster, Dot, Dots, Window Circle, Crosshatch, and EIA Color Bars VIDEO PATTERNS (1a-e, h) are selected.

11. **STD Y/C OUTPUT Jack** - Supplies separate luminance (Y) and chrominance (C) signals to standard Y/C connector. Signals are determined by setting of VIDEO PATTERN Switch (1).

12. **PULL CHART** - Provides simplified instructions and reference material.

13. **POWER ON/OFF Switch** - Applies and removes AC power to the unit.

14. **AFT TEST Buttons** - Momentary push buttons shift the frequency of the RF channel or 45.75 MHz Video IF 500 kHz above or below the normal frequency.

15. **RF Channel Keyboard** - Use to select desired STD TV or CABLE channels when RF-IF SIGNAL switch is set for an RF signal (19 a-d). Use arrow keys to increment channels up or down.

16. **RF-IF OUTPUT JACK** - SUPPLIES RF AND IF signals selected by RF-IF SIGNAL switch (19).

17. **RF-IF LEVEL Control** - Provides fine adjustment for signals selected by the RF-IF SIGNAL Switch (19) and available at the RF-IF OUTPUT Jack. (16).

18. **RF-IF RANGE Switch** - Provides coarse level adjustment for the signals selected by the RF-IF SIGNAL switch (19) and available at the RF-IF OUTPUT Jack (16).

19. **RF-IF SIGNAL Switch** - Determines the RF and IF signal available at the RF-IF OUTPUT Jack (16).
a. **STD TV** - Provides VHF and UHF off-air TV channels 2-69.

b. **STD CABLE**- Provides all RF cable channels 2-125 at FCC specified frequencies.
c. **HRC CABLE** - Provides RF cable channels 1-125 at HRC shifted carrier frequencies.
d. **ICC CABLE** - Provides RF cable channels 1-125 at ICC shifted carrier frequencies.
e. **45.75 MHZ VIDEO IF** - Provides video and aural IF carriers modulated with video and audio.
f. **47.25 MHZ ADJ SND TRAP** - Provides a signal to dynamically check and adjust the sound IF trap.
g. **41.25 MHZ SND TRAP** - Provides a signal to dynamically check and adjust the sound IF trap.
h. **39.75 MHZ ADJ VID TRAP** - Provides a signal to dynamically check and adjust the adjacent channel video IF trap.
i. **4.5 MHZ FM** - Provides an FM sound IF carrier modulated with audio.

20. **RF-IF Digital Readout** - Displays the RF channel, IF frequency, and IF trap frequency selected by RF-IF SIGNAL Switch (19).

21. **DOT SIZE Control** - Use to adjust the size of dots and width of vertical lines in all video patterns that contain dots or vertical lines.

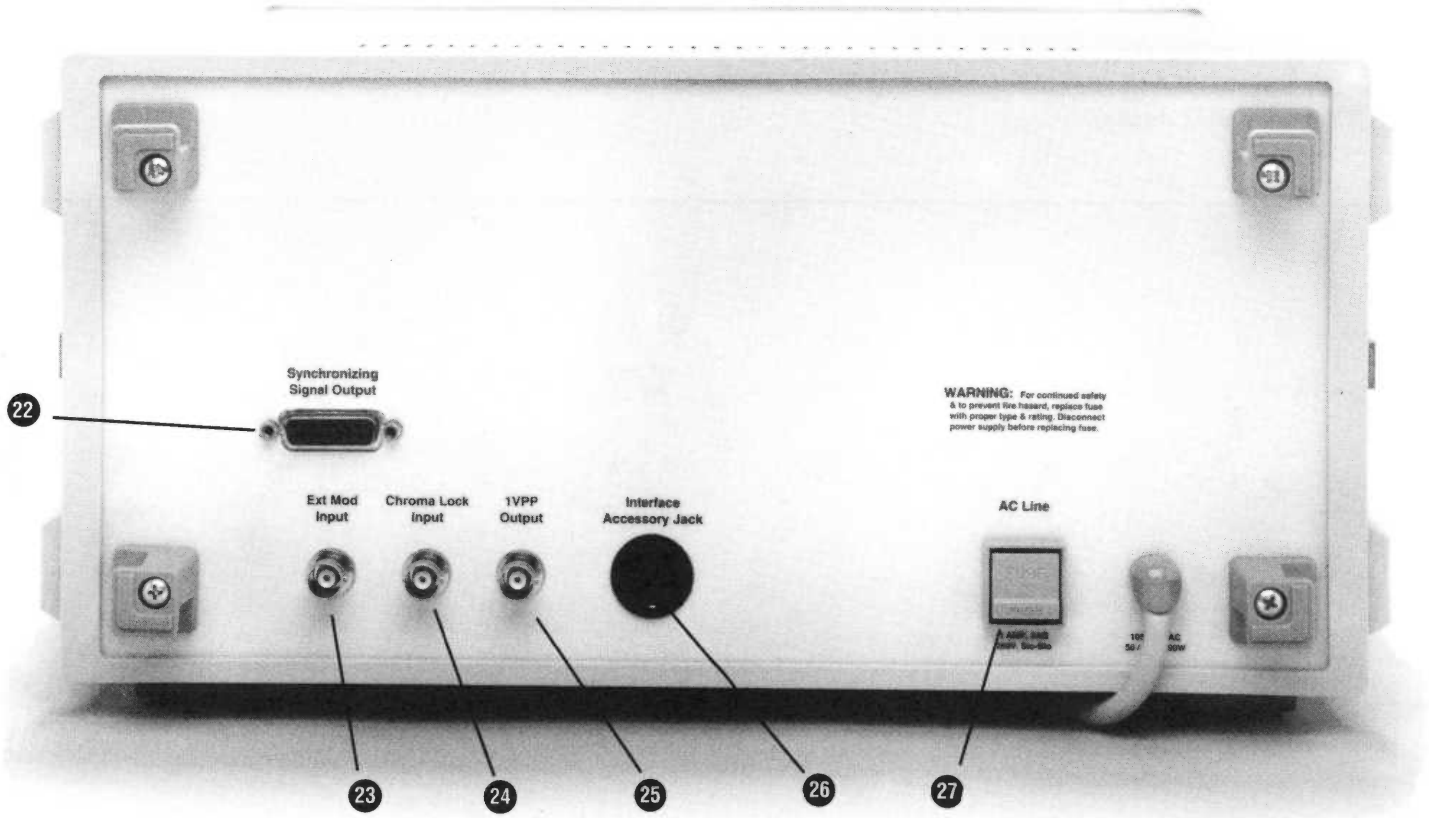


Fig. 2 - VG91 Rear Panel Feature

REAR PANEL FEATURES

22. **SYNCHRONIZING SIGNAL OUTPUT Jack** - Provides internal voltages, sync and video signals to companion analyzers and accessories.

23. **EXTERNAL MODULATION Input** - Provides a BNC input for a standard composite video modulation source. The VIDEO PATTERN Switch must be in the "External Modulation" position (11).

24. **CHROMA LOCK input** - Jack receives a SW30 signal from VC93 "All Format VCR Analyzer" to phase lock the video vertical sync when isolating VCR color problems using VG91 video patterns.

25. **1 VPP OUTPUT Jack** - BNC connecter provides standard composite video output of video pattern selected by VIDEO PATTERN Switch (1).

26. **INTERFACE ACCESSORY Jack** - Provides connection for the optional IB72 IEEE 488 Bus Accessory (38) or IB78 RS232 Interface Accessory (39).

27. **AC LINE FUSE** - Protects VG91 from damage due to internal problems which cause excessive current draw. Replace with 1 Amp, 3AG, 250 volt Slo-Blo.

SUPPLIED ACCESSORIES

28. **RF-IF TEST CABLE** (39G301) - Provides a 75 ohm BNC to quick-connect F-connector cable for use with RF-IF Output Jack (16).

29. **S-VIDEO Y/C CABLE** (39B270) - Provides a 4 pin miniature jack male to 4 pin miniature jack male for use with the STD Y/C OUTPUT Jack (11).

30. **VIDEO TEST CABLE** (39B296) - Provides a 75 ohm RCA phono to RCA phono cable for use with the STD VIDEO OUTPUT Jack (8).

31. **AUDIO TEST CABLE** (39B241:A) - Provides a RCA phono to RCA phono cable for use with the STD AUDIO OUTPUT Jack (5).

32. **RF-IF TROUBLESHOOTING BALUN** (39A302) - Provides 75 to 300 ohms matching transformer with DC blocking secondary for use with RF-IF TEST CABLE (28) when injecting signals into tuner or IF stages.

33. **F TO RCA FEMALE ADAPTER CABLE** (39A161:A) - Short adapter cable "F" to RCA Female to connect RF-IF TEST CABLE (28) to tuner or chassis.

34. **F TO RCA MALE ADAPTER CABLE** (39A162:A) - Short adapter cable "F" to RCA male to connect RF-IF TEST CABLE (28) to tuner or chassis.

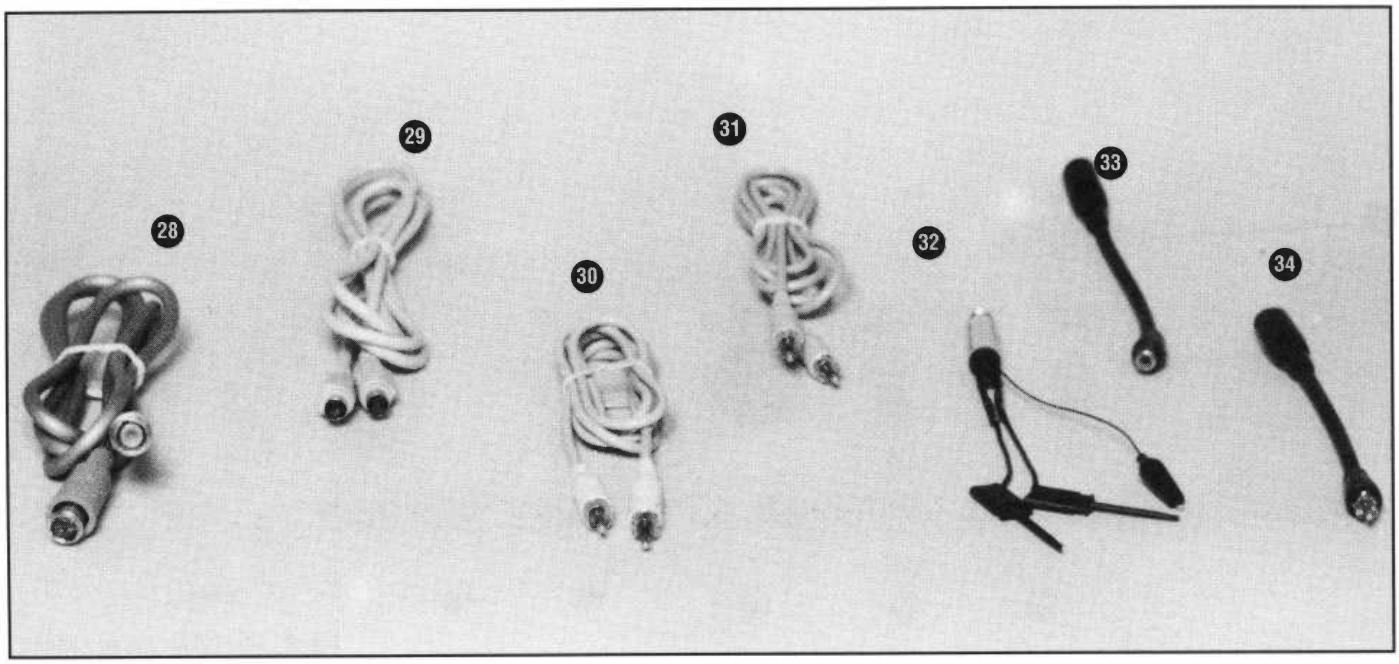


Fig. 3 - Supplied Accessories

OPTIONAL ACCESSORIES

35. **BNC CABLE** (39G232) - BNC to BNC cable for use with rear panel jacks.

36. **SYNCHRONIZING INTERCONNECT CABLE** (39G266) - Provides a connection between the SYNCHRONIZING SIGNAL OUTPUT Jack (22) and Sencore companion analyzers or expanding accessories.

37. **RF - IF MATCHING BALUN** (39G72) - Provides 75 to 300 ohms matching transformer with DC blocking secondary for use with RF-IF TEST CABLE (28) for connecting to rear antenna terminals or chassis.

38. **IB72 IEEE 488 BUS INTERFACE ACCESSORY** - Connects between the INTERFACE ACCESSORY Jack (26) and the IEEE port of a bus controller to allow the VG91 to be used on a IEEE system

39. **IB78 RS232 INTERFACE ACCESSORY** - Connects between the INTERFACE ACCESSORY Jack (26) and the RS232 port of a controller to allow the VG91 to be used for automated testing

40. **PC259 FRONT PANEL PROTECTION COVER** - Snap on cover to protect front panel and provide lead storage.

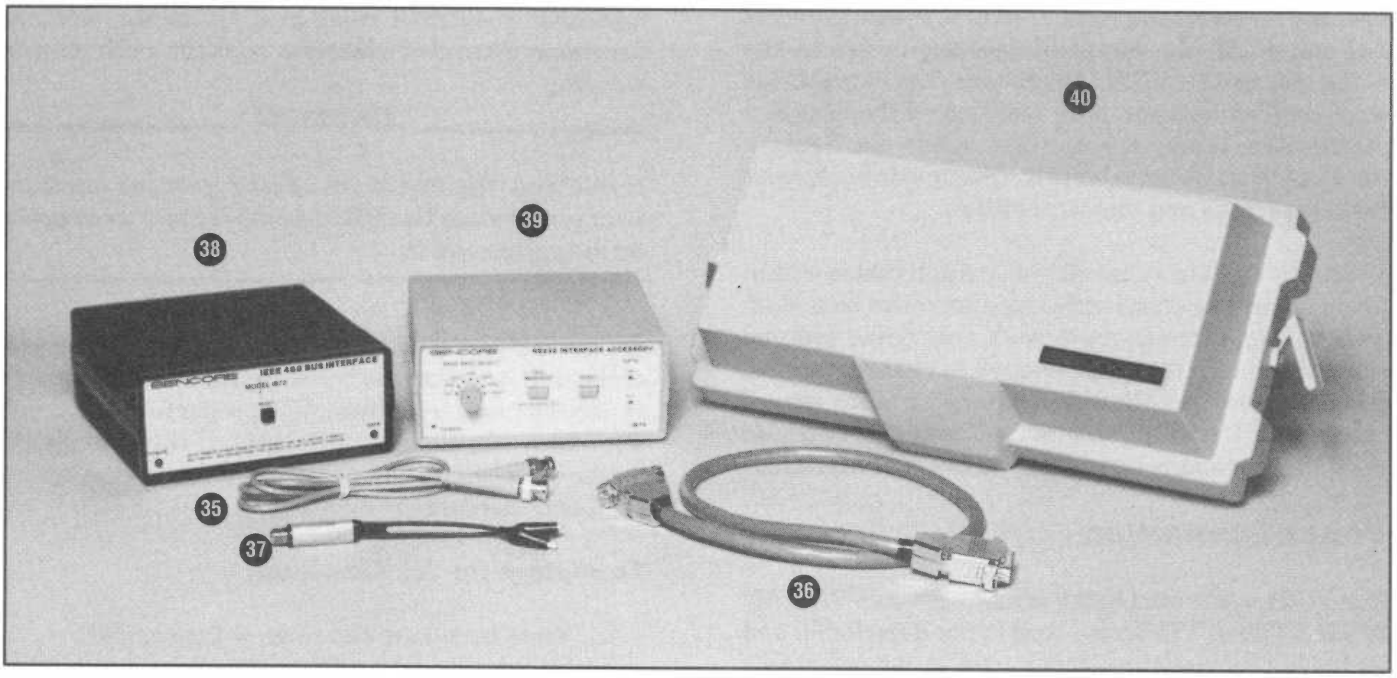


Fig. 4 - Optional VG91 Accessories

OPERATION

INTRODUCTION

This portion of the manual explains how to prepare the VG91 for operation and describes how to use its controls and features. It consists of five parts: 1) Preparation For Use, 2) RF-IF Signals, 3) Video Patterns, 4) MTS/Audio Generator, and 5) Computer Automated Bus Operation. Once you have become familiar with the features and operation of the VG91 you can operate it using information on the front panel and on the Pull Chart. The APPLICATION section of this manual provides information on performance testing, alignment, and troubleshooting methods using the VG91.

PREPARATION FOR USE

The VG91 is ready for use when it is removed from its packing material and connected to a proper source of AC power. All the Supplied Accessories are in the same box as the VG91. When you first unpack the unit, confirm that you have received all the Supplied Accessories. If any are missing, notify the Sencore Service Department promptly. (See inside back cover for the address and phone number.)

Place the VG91 in a convenient location that is within about 30 inches of the video equipment to be tested. This will provide adequate work area while keeping the video equipment close enough to connect the test leads. Do not block the air vents located to the rear of the case. If the VG91 will be used with a companion unit, the units may be stacked on top of one another.

Power Connection

The VG91 is powered by a standard 105-125 VAC, 50/60 Hz AC line. The power cord is not detachable and includes a third-wire safety ground. Do not defeat this third-wire ground as it is necessary for proper shielding, operation and safety.

To operate the VG91 from an AC line:

1. Connect the power cord to a properly grounded, 105-125 VAC power source.

2. Press the POWER switch on the front of the VG91 to on. The switch will illuminate to show that the unit is receiving power. If the light does not illuminate;
   a. Confirm that the AC power source is correct
   b. Check the VG91 AC line fuse.

3. After applying power, allow approximately 5 seconds for the internal circuitry to reset to full operation.

The VG91 is fully operational when the LCD readout and LED indicators clear and set to the selected functions. Specified accuracy requires a 20 minute warmup.

CAUTION

Defeating the 3rd wire safety ground connection may cause the VG91 to operate incorrectly or may damage it.

AC Line Fuse - An AC line fuse, located on the rear of the unit, protects the VG91 from excessive damage caused by internal failures. The proper fuse value is 1 amp, 250 volt, Slo-Blo, type 3AG. If the fuse blows, locate the cause of the problem and correct it before replacing the fuse.

To replace the AC Line Fuse:

1. Press to release the snap-in fuse holder.
2. Pull the holder and fuse out of the fuse holder base.
3. Replace the fuse with same type and rating.
4. Insert the holder and fuse into the fuse holder base and snap it back into place.

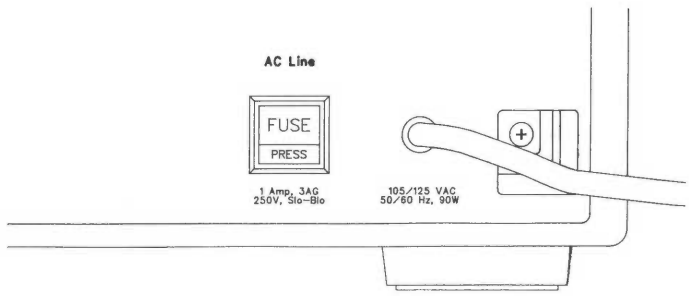


Fig 5. - If the VG91 fails to power up when the Power switch is on, check the AC line fuse

CAUTION

Using the wrong AC line fuse may damage the VG91. Replace only with a 1 amp, 250 volt, Slo-Blo type 3AG fuse.

Operation With Companion Analyzers Or Accessories

The VG91 provides the necessary RF, IF, video and audio signals to performance test, troubleshoot, and align all of the stages from the antenna to the video and audio detectors in a video system. Defects in the IF stages can be isolated with signal injection.

The VG91 is designed so that it can be combined with a companion analyzer, such as the VC93 All Format VCR Analyzer or the TVA92 TV Video Analyzer to form a specialized video analyzing team. Together, the VG91 and companion unit thoroughly analyze and pinpoint defects in VCRs, television receivers, video monitors, and other video systems. The VG91 provides synchronized signals and video patterns needed by the companion units.

Connecting The VG91 To Accessories Or Companion Analyzers

The VG91 supplies DC voltages, video, audio, and sync signals to companion units or accessories. Consult the operation and application manual of the companion analyzer or accessory for specific details on using it with the VG91.

Use the (optional) 39G266 SYNCHRONIZING INTERCONNECT CABLE to supply the VG91's signals to the companion analyzer or accessory. This cable connects between the VG91's SYNCHRONIZING SIGNAL OUTPUT jack and the SYNCHRONIZING SIGNAL INPUT jack on the companion unit.

To connect the VG91 to a companion analyzer or accessory:

1. Turn off the power to both units.
2. Connect one end of the SYNCHRONIZING INTERCONNECT CABLE to the SYNCHRONIZING SIGNAL OUT jack located on the rear of the VG91.
3. Connect the other end of the SYNCHRONIZING INTERCONNECT CABLE to the SYNCHRONIZING SIGNAL IN jack located on the rear of the companion unit.
4. Tighten the screws that hold the cable connectors to each unit. Be careful to not over tighten.
5. Turn power on to each unit.
6. Select the desired video pattern and audio signals on the VG91.

Note: The companion units have a SYNCHRONIZING SIGNAL OUTPUT jack which provides a feed-through for the VG91's synchronizing signals to feed multiple companion units.

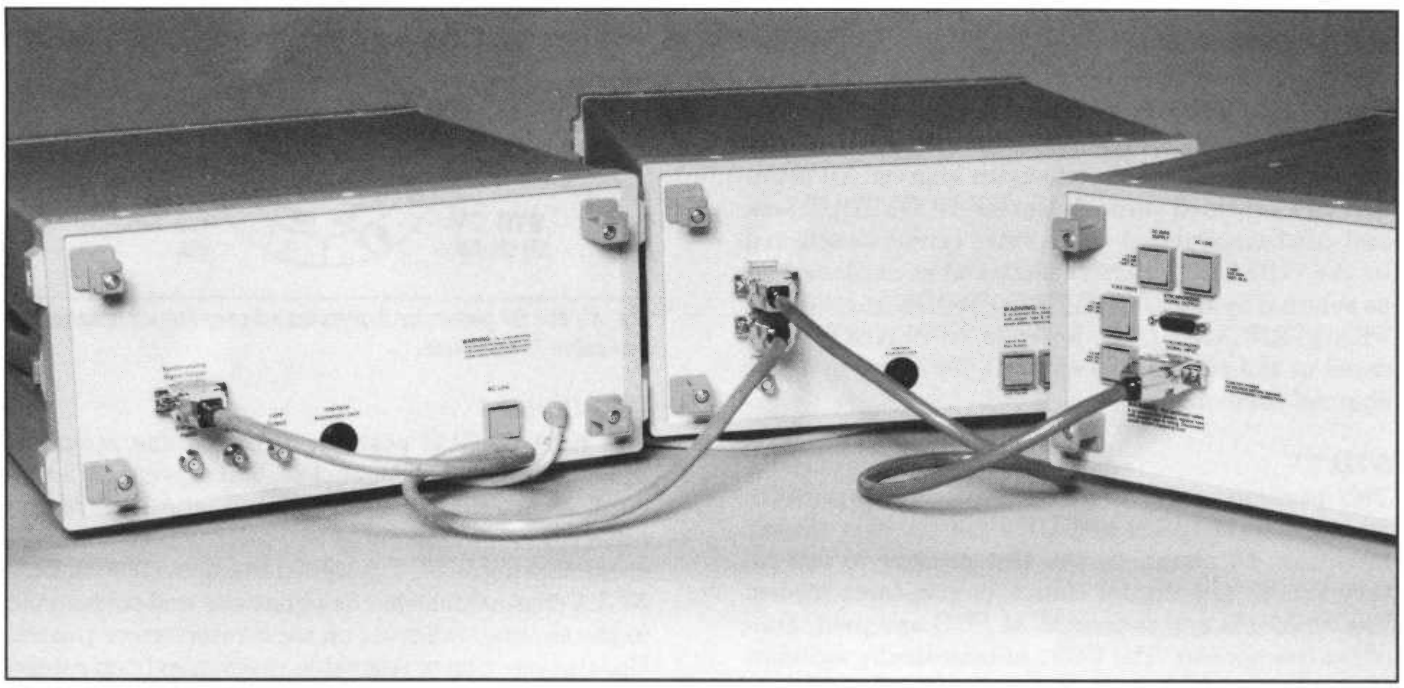


Fig. 6 - The VG91 provides signals to companion analyzers or accessories using the (optional) Synchronizing Interconnect Cable.

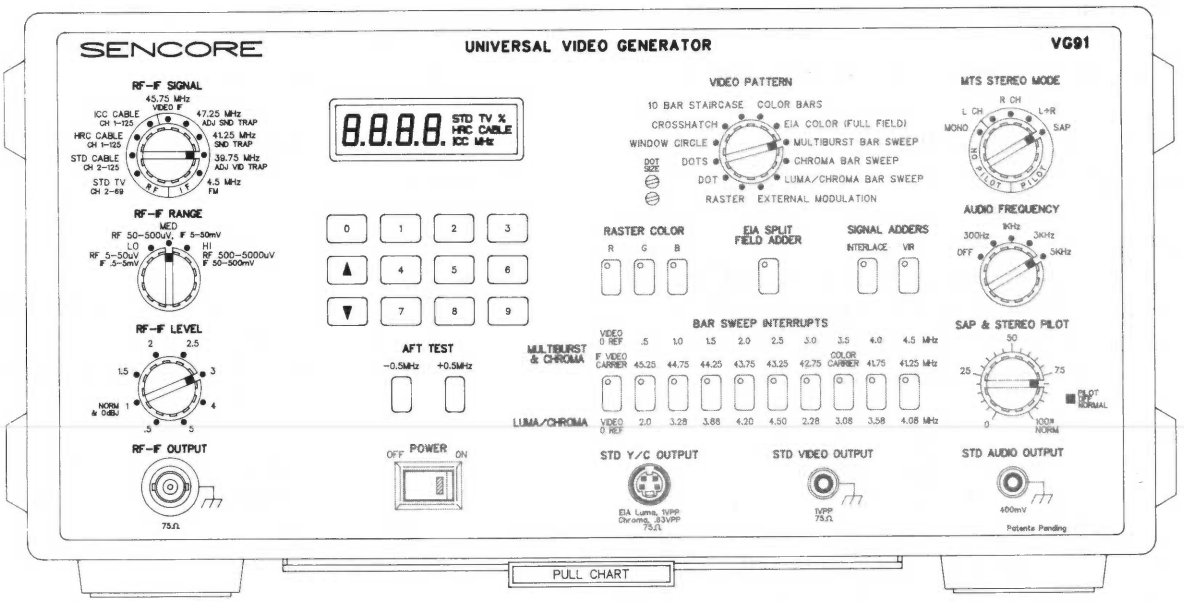


Fig. 7 - The RF-IF generator portion provides the signals used to test, troubleshoot and align the stages before the video and audio detectors

The RF-IF generator portion of the VG91 provides the signals used in the stages before the video or audio detectors in a receiver that tunes television signals. This section provides information necessary to use the VG91's RF and IF signals. Refer to the APPLICATIONS section for more detailed information on using the RF and IF signals for testing, aligning and troubleshooting video systems.

RF Generator

The RF generator section has 4 groups of channels that duplicate the frequency assignments of over-the-air broadcast and cable television signals. All channels are provided through the RF-IF OUTPUT jack and can be modulated with a video carrier as selected by the VIDEO PATTERN switch and an audio carrier as selected by the MTS STEREO MODE and AUDIO FREQUENCY controls. Refer to APPENDIX A, located at the rear of this manual, for a listing of the channel frequencies.

STD TV

This position of the RF-IF SIGNAL switch provides standard VHF (2-13) and UHF (14-69) over-the-air broadcast TV channels. Use this position to test rotary tuners and digital tuners in non-cable modes. The channels are generated at FCC assigned, non-offset frequencies. The VG91 automatically switches from VHF to UHF as the channels are selected.

Note: Remember to move the RF cable between the VHF and UHF antenna terminals if the receiver is equipped with separate terminals.

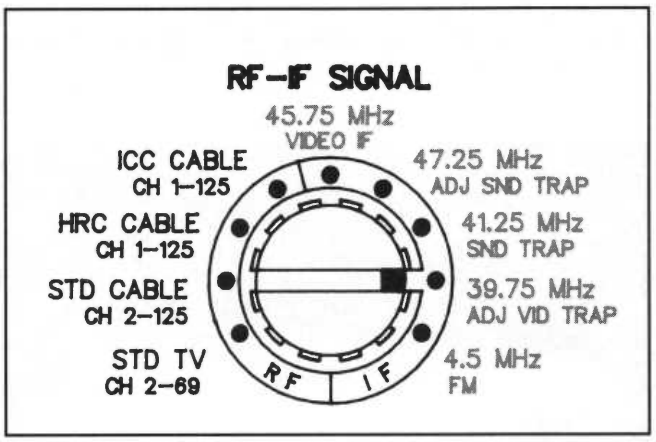


Fig. 8 - The RF generator duplicates all over-the-air broadcast and cable TV channels.

STD Cable

The STD CABLE position produces the standard cable channels 2 through 125. This covers all standard VHF, mid-band, super-band, and hyper-band cable channels from 50 to 800 MHz. These channels are generated on FCC assigned frequencies with EIA/NCTA channel number designations and correspond to the channel readouts on most receivers or tuners. Use this position to test cable ready television receivers and tuners.

Note: Most receivers have a means to switch between standard VHF/UHF and cable channel tuning. Set the receiver to the "Cable" mode to allow cable channels 1 - 125 to be received through the RF input or VHF antenna terminals.

HRC Cable

The HRC (Harmonically Related Carriers) CABLE position of the RF-IF SIGNAL switch produces HRC cable channels 1 through 125. All of the HRC cable carriers are shifted - 1.25 MHz from the FCC assigned (STD cable) frequencies, except channels 4 and 5. Channel 4 and 5 are each shifted + 0.75 MHz. An additional channel, designated channel 1, is created between channel 4 and 5. Other designations for this added channel are 4+, 5A, or A-8. The VG91's HRC CABLE channels duplicate the carrier frequencies of an HRC cable system, including the additional channel 1 for testing HRC compatible receivers.

ICC Cable

The ICC (Incremental Coherent Carriers) CABLE position of the RF-IF SIGNAL switch produces ICC cable channels 1 through 125. In this position, channels 4 and 5 are each shifted + 2.00 MHz from the FCC assigned (STD cable) frequency. An additional channel, designated channel 1, is created between channels 4 and 5. The VG91's ICC CABLE channels duplicate the carrier frequencies of an ICC cable system including the additional channel 1 for testing ICC compatible receivers.

You may encounter some variations in cable channel numbering as you test digital tuners. The most common variation in cable channel numbering is in the FM band 88-108 MHz. In the past many tuners only tuned up to cable channel 68. The RF television channels in the 88-108 MHz band were numbered 69-73. Newer receivers commonly tune the channels in the FM band and number them as channels 95-99.

The VG91 follows the TV cable channel designation standard established by the EIA. This standard designates channels 95-99 as the FM band TV channel. Although not mandatory, most manufacturers follow this scheme so the receiver will usually agree with the VG91's digital readout. If you are not sure of the receiver's numbering scheme, check the service literature.

Selecting Channels

The channels may be selected using either of two methods; directly using the keyboard, or sequenced up or down using the up/down arrow keys.

To use the keyboard enter a 1, 2 or 3 digit number corresponding to the desired channel. Channels 1-9 only require a one digit entry and channels 10-99 only require a two digit entry - a leading "0" or "00" is not required. When a 1 or 2 digit number is entered, the VG91 waits 2 seconds for another digit entry. If another digit is not entered within this time the VG91 goes to the entered 1 or 2 digit channel. The VG91 recognizes entries with a leading "0" before the channel numbers such as "06" or "025". If you enter a valid three digit number, such as "005" the VG91 immediately goes to the desired channel without a delay.

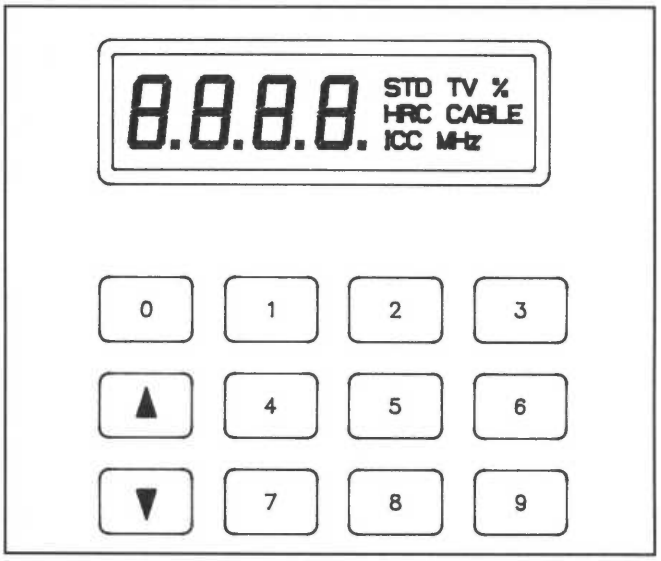


Fig. 9 - Use the keypad and digital display to select or increment through TV-RF channels.

As the digits are entered on the keypad they appear in the leftmost portion of the digital display. If the entry is a valid channel number, the number moves to the right side of the display and the channel is available at the RF-IF OUTPUT jack. If the entry is a not a valid channel number, the display and output default to the previous channel. If you make a mistake entering a channel number, wait briefly for the generator to clear and then select the digits of the desired channel.

You may increment one channel at a time through RF-TV channels using the keypad's up or down arrow keys. Each time you press an arrow key the generator will step one channel. If the up or down key is held down the VG91 will continually step through the RF-TV channels until you release the key. The channel steps automatically rollover at the top and bottom channels.

Note: Pushing the "up" or "down" key automatically increments all of the "cable" channels. Incrementing a "cable" channel will not increment the "STD TV" channel, or vice versa.

The "STD TV" and the "Cable" channel numbers are entered separately. You can enter one channel

number for "STD TV" and a different number for the "CABLE" channel group. For example, you can enter channel "12" in the "STD TV" and channel "50" in "STD CABLE". After you have entered the channel numbers, the channel display and output will switch between the two channels as you change the RF-IF SIGNAL switch. (The channel for the "STD Cable", "HRC Cable" and "ICC Cable" positions are the same. The same channel number for all three can be entered with the RF-IF SIGNAL switch set to any of the "cable" positions). This feature provides a quick way to switch between two different channels.

The VG91 remembers the channels ("STD TV" and "Cable") it was last tuned to when the AC power is turned off, or when the unit is unplugged. These channels are active when the unit is turned back on and one of the RF channel positions of the RF-IF SIGNAL switch is selected.

RF Signal Connections

All of the VHF, UHF and cable channels are fed through the RF-IF OUTPUT jack. The RF-IF TEST CABLE is used to connect the VG91 to the F-connector found on most of today's television-signal receivers. Some receivers, especially older models, have screw terminals instead of an F-connector for the RF signal connection. Use a balun to connect to these screw terminals. Any CATV balun will work, but be sure to use a high frequency, low loss balun, such as the (optional) 39G72 RF-IF MATCHING BALUN when testing the high UHF channels.

RF Attenuator

The RF channel output level is adjustable from 5 µV to 5 mV in 3 ranges with the RF-IF RANGE and RF-IF LEVEL controls. Markings around the RF-IF RANGE control indicate the range of the RF output level in each position. Use the RF-IF LEVEL vernier control to adjust the output level within the selected range. The markings around the vernier indicate the signal level at the output. For example, with the RANGE control set to "HI" and the LEVEL control set to "1", the output is 1000µV.

The attenuator is microprocessor compensated for each individual channel to insure a flat output at the "1" or normal vernier position for all channels. This insures reliable tests of receiver sensitivity at any channel. Table 1 shows the different levels provided for each setting of the RF-IF RANGE and RF-IF LEVEL controls. The values listed are ideal levels delivered into a 75 ohm load such as the coaxial input of a receiver or the input to a balun.

RF-IF LEVEL SIGNAL RANGE	RF-IF LEVEL CONTROL SETTING			
	.5	1(norm)	2.5	5
Lo	5 µV	10 µV	25 µV	50 µV
Med	50 µV	100 µV	250 µV	500 µV
Hi	500 µV	1000 µV	2500 µV (2.5 mV)	5000 µV (5 mV)

Table 1 - RF signal output levels for various settings of the RF-IF RANGE and RF-IF LEVEL controls.

Modulation

The video carrier of the selected TV channel is modulated with the video signal selected by the VIDEO PATTERN switch. The modulation closely matches broadcast television and cable signals for accurate tests and alignments. The patterns are explained in a later section of this manual.

Some special tests and alignments require an RF carrier that is unmodulated, or that is modulated only by sync information. To completely remove modulation from the video carrier, make sure nothing is connected to the rear EXTERNAL MODULATION jack, then select the "External Modulation" position of the VIDEO PATTERN switch. To modulate the video carrier with only sync information, select the "MULTIBURST BAR SWEEP" VIDEO PATTERN and turn off all BAR SWEEP INTERRUPT Switches for a black raster.

The audio carrier of the selected TV channel can be modulated with a mono or composite stereo audio signal at 300, 1 k, 3 k and 5 kHz. The modulation closely matches broadcast television and cable signals for accurate tests and alignments. The audio frequency is selected with the AUDIO FREQUENCY switch, and mono or stereo modulation is selected with the MTS STEREO MODE switch. The SAP & STEREO PILOT control must be set to "100% NORM" for a normally modulated MTS stereo or SAP signal. To remove all audio modulation set the AUDIO FREQUENCY switch to "OFF".

To use the RF TV or Cable Channel Generator:

1. Set the RF-IF SIGNAL switch to desired TV or Cable format.
2. Set the RF-IF RANGE to "HI".
3. Set the RF-IF LEVEL to "1".
4. Select the desired video modulation with VIDEO PATTERN switch.
5. Select the desired audio modulation with MTS STEREO MODE, AUDIO FREQUENCY and SAP & STEREO PILOT controls.
6. Use keypad and digital readout to select the desired RF channel.
7. Connect the RF-IF TEST CABLE to the receiver's RF or antenna input.

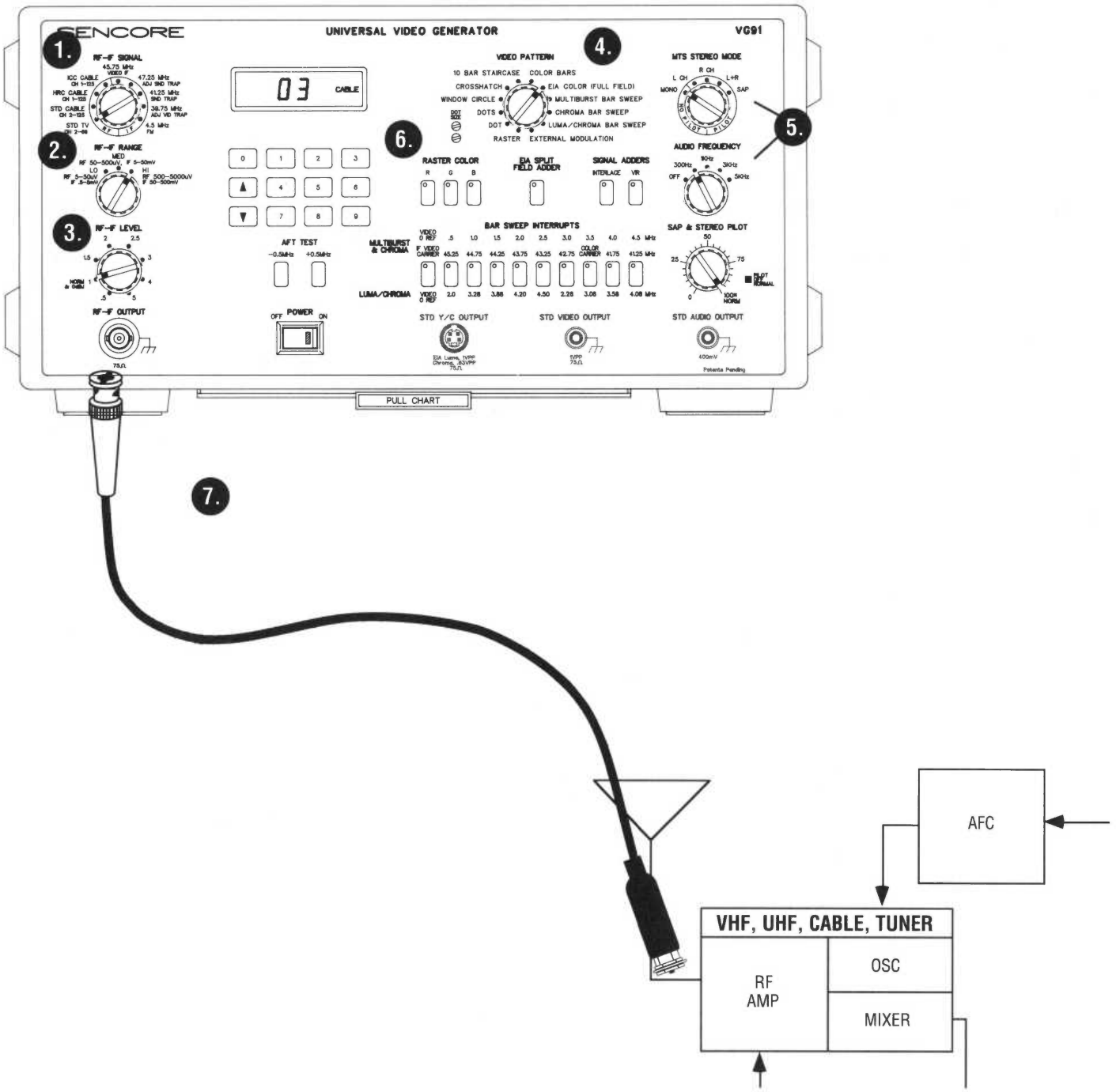


Fig. 10 - Use the RF generator to test television-signal tuners.

IF Generator

The VG91 IF Generator provides modulated signals to troubleshoot or align the Video IF and Sound IF stages of a television-signal receiver. The IF Generator has 3 main sections: 1) 45.75 MHz Video-IF, 2) Video IF Trap setting signals, and 3) 4.5 MHz Sound IF generator.

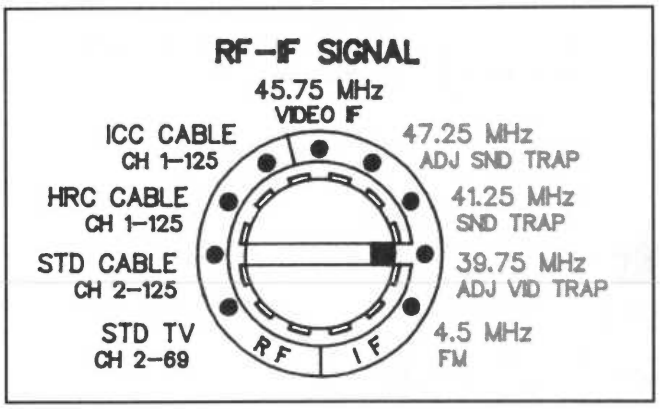


Fig. 11 - The IF generator provides a signal to test, troubleshoot, and align the IF section of a television-signal receiver.

IF Signal Connections

All of the IF signals are supplied through the RF-IF OUTPUT jack. Three options are supplied with your VG91 for making connections to the chassis: 1) Troubleshooting Matching Balun, 2) F-connector to RCA-female Adapter, and 3) F-connector to RCA-male Adapter. Each of these options connects to the F-connector end of the RF-IF Test Cable and provides a different connection option to match the connector in the chassis.

Many older model receivers have a link cable that connects the output of the tuner to the IF input. These cables usually have an RCA connector on one end. Disconnect one end of this link cable and use one of the supplied RCA adapters to make connections in these chassis.

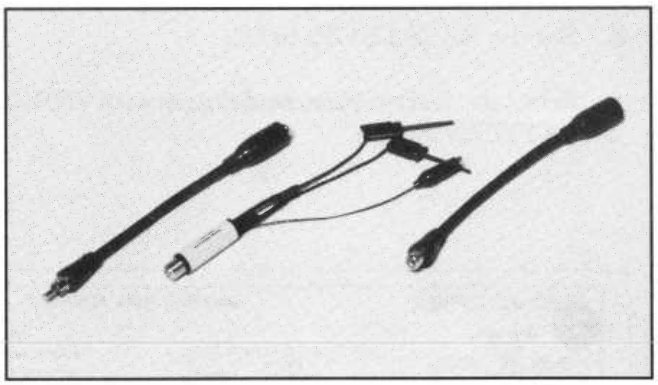


Fig. 12 - Three options are supplied to connect to the IF stages.

In many newer receivers the tuner module is soldered directly to the circuit board that contains the IF stages. Often differential amplifiers are used and neither of the input points is at common circuit ground. You will need to use the Troubleshooting Matching Balun to make connection in these IF stages. The IF Troubleshooting Matching Balun supplied with the VG91 contains blocking capacitors to prevent upsetting the DC voltage at a test point. Special clips are also provided to allow easy connection to the circuit. The IF Troubleshooting balun can be used to make connections in differential and non-differential circuits.

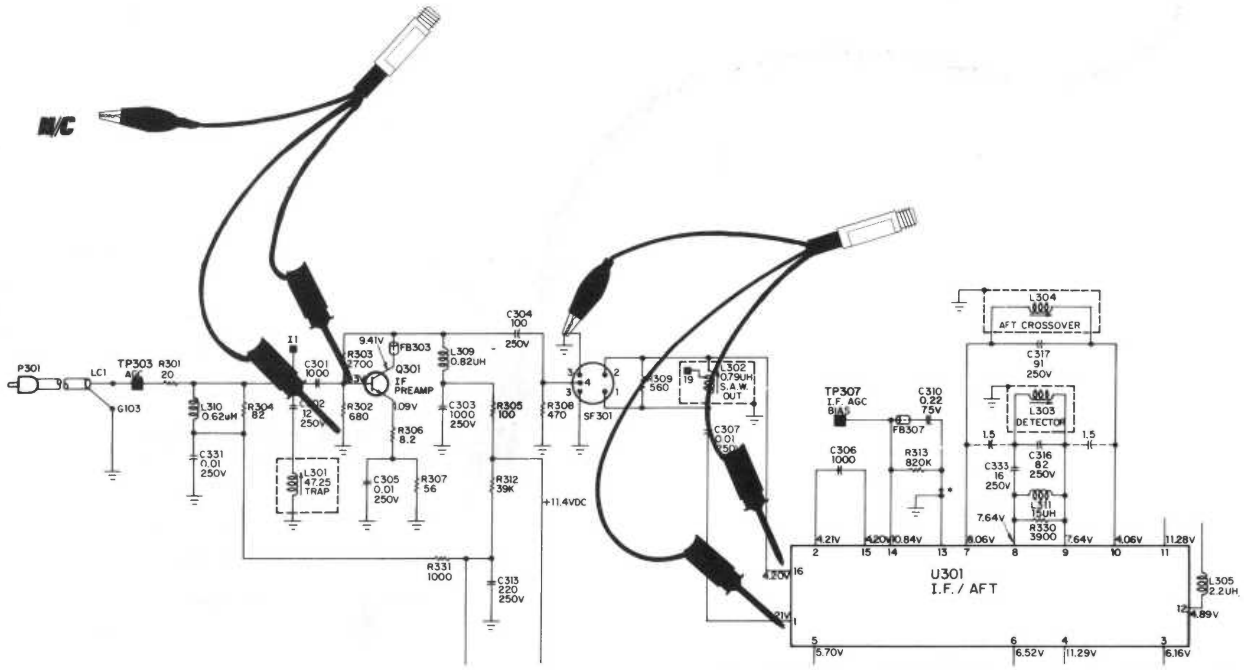


Fig. 13 - The IF Troubleshooting Balun can be used to connect to differential input circuits, and circuits that have a common ground.

WARNING

Do not use a regular CATV-type balun to make connection to IF stages. Some circuit test points have a DC potential which will be shorted using a conventional balun. Only use the 39A302 RF-IF TROUBLESHOOTING BALUN which contains special DC blocking capacitors.

45.75 MHz Video IF Generator

The "45.75 MHz Video IF" position of the RF-IF SIGNAL switch produces a crystal accurate 45.75 MHz carrier for substituting into the video IF stages of a television-signal receiver. Use this signal to troubleshoot and align the video IF stages.

The video carrier is fully modulated by the video selected by the VIDEO PATTERN switch. A modulated sound carrier can also be added using the MTS STEREO MODE and AUDIO FREQUENCY controls. The modulation allows the results of the injection to be easily monitored. When applied at the correct level to properly working IF stages, video and audio information appears at the corresponding detector outputs.

To use the 45.75 MHz Video IF signal:

1. Set the RF-IF SIGNAL switch to "45.75 MHz Video IF".
2. Set the RF-IF RANGE switch to "LO".
3. Set the RF-IF LEVEL control to "1 (Normal 0 dB)".

Note: Set the RF-IF RANGE to "MED" when testing receivers that have an IF amplifier located in the tuner module.

4. Select the desired video modulation with the VIDEO PATTERN switch.
5. Select the desired audio modulation using the MTS STEREO MODE, AUDIO FREQUENCY, and SAP & STEREO PILOT controls.
6. Connect the RF-IF TEST CABLE to the IF stage using the either of the supplied RCA phono adapter cables, or the IF Troubleshooting Balun.

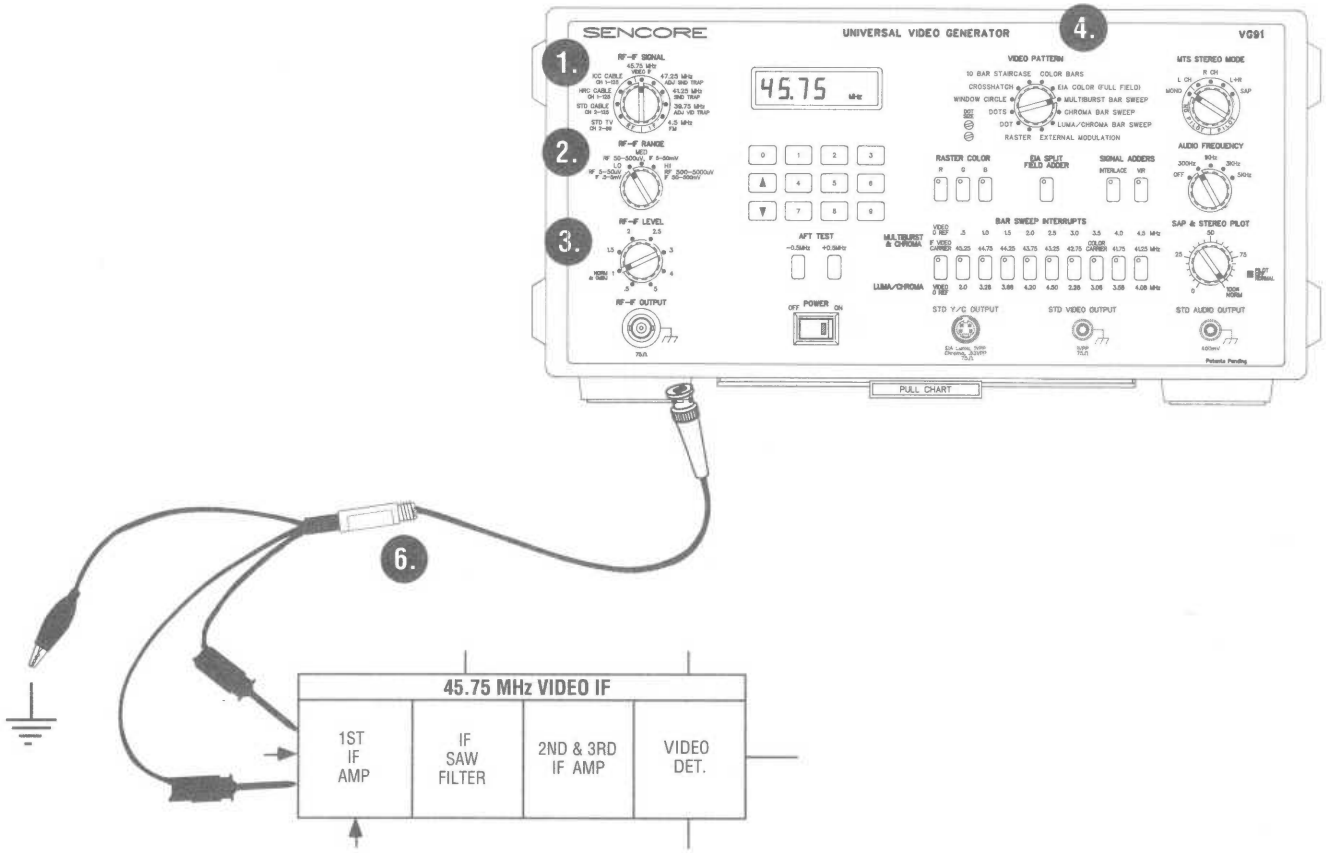


Fig. 14 - The VG91's fully modulated Video IF signals can be substituted into the IF stages for troubleshooting or alignments.

Trap Setting Signals

The VG91 produces three special signals that are used to dynamically check and align the traps that are commonly found in the video IF stages of a television-signal receiver. Using these signals, the traps can be tested and aligned while viewing the picture on the CRT, or by viewing the composite video signal at the Video Out jack with an oscilloscope.

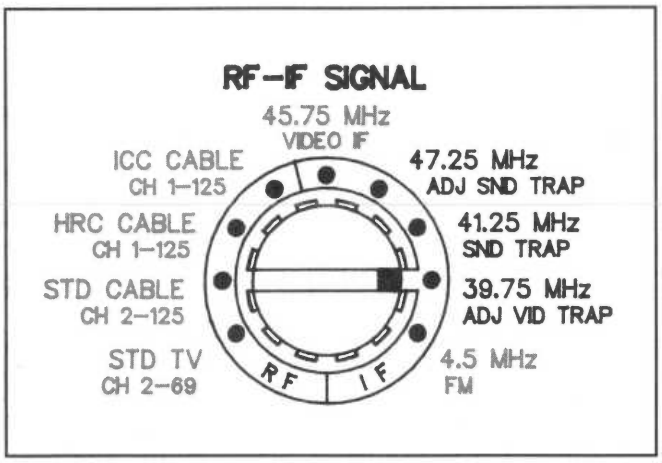


Fig. 15 - Use the trap signals to dynamically test and align the traps found in the video IF stages.

The special trap signals consist of a modulated 45.75 MHz video IF signal combined with an interference carrier at either 39.75 MHz, 41.25 MHz or 47.25 MHz. The 45.75 MHz carrier is produced at a fixed, 1000 µV level and duplicates the signal normally found in the IF stages. This locks the AGC to keep the gain of the first IF amplifier constant during adjustments, and also provides a viewable output.

The interference carrier duplicates the unwanted interference that the IF stages are supposed to filter out; (39.75 MHz = upper adjacent channel video; 41.25 = on channel sound; 47.25 = lower adjacent channel sound). The RF-IF RANGE and RF-IF LEVEL controls vary the level of the interference carrier to allow more or less interference to be introduced into the IF. The interference carrier can be left unmodulated, or it can be modulated with any of the four frequencies selected by the AUDIO FREQUENCY switch. Modulating the interference carrier makes the interference more visible on a CRT or scope.

The IF traps are adjusted by observing the CRT or and/or an oscilloscope display until the amount of interference is nulled. The Multiburst Bar Sweep or 10 Bar Staircase video patterns provide the best visibility. Refer to the APPLICATIONS section of this manual for more information on the trap setting signals.

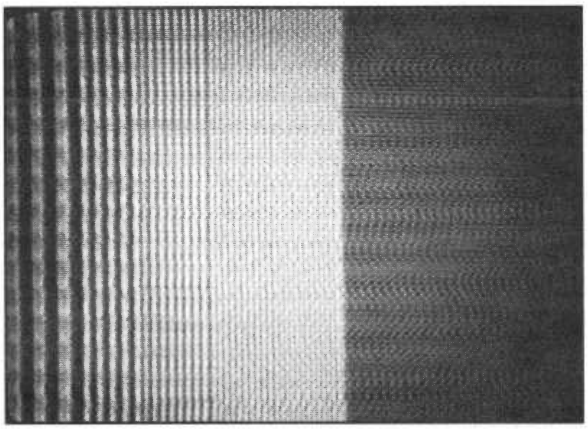


Fig. 16 - A misaligned trap causes picture interference. Adjust the trap for minimum picture interference.

To Use the Trap Setting Signals:

1. Connect the RF-IF TEST CABLE to the first IF stage using the either of the supplied RCA phono adapter cables, or the IF Troubleshooting Balun.

2. Set the RF-IF SIGNAL switch to the desired IF Trap signal.

3. Select the Multiburst Bar Sweep or 10 Bar Staircase video pattern.

4. Set the RF-IF RANGE switch to "LO" and the RF-IF LEVEL control to "1".

5. Adjust the LEVEL control so that the interference caused by the trap carrier is barely visible.

Note: You may modulate the trap-signal by selecting any of the frequencies of the AUDIO FREQUENCY Switch.

6. Adjust the corresponding trap for minimum interference as shown on the CRT, or on an oscilloscope connected to the video detector output or VIDEO OUT jack.

4.5 MHz FM Sound IF Generator

The "4.5 MHz FM" position of the RF-IF Signal switch produces an FM modulated carrier that is used for troubleshooting the sound IF stages of a television-signal receiver. The carrier is unmodulated if the AUDIO FREQUENCY switch is set to "Off". It can be modulated with mono or stereo audio, depending on the setting of the MTS STEREO MODE switch, and with any of the four audio frequen-

cies provided by the AUDIO FREQUENCY switch. When you inject this signal in to properly working sound IF stages, audio will appear at the speaker output or AUDIO OUT jacks.

To use the 4.5 MHz FM Signal:

1. Set the RF-IF SIGNAL switch to "4.5 MHz FM".
2. Connect the RF-IF TEST CABLE to the sound IF using either of the supplied RCA phono adapter cables, or the IF Troubleshooting Balun.
3. Select the desired modulation with the AUDIO FREQUENCY, MTS STEREO MODE, and SAP & STEREO PILOT controls.
4. Adjust the output level with the RF-IF RANGE and RF-IF LEVEL controls.

IF Attenuator

The IF output is adjustable from 500 µV to 500 mV in 3 ranges with the RF-IF RANGE and RF-IF LEVEL controls. Markings around the RF-IF RANGE control indicate the range of the IF output level in each position. Use the RF-IF LEVEL vernier control to adjust the output level within the selected range. The markings around the vernier indicate the signal level at the output. Note that these values are 100 times larger than the RF output levels to properly match the higher signal levels found in the IF circuits. For example, with the RANGE control set to "HI" and the LEVEL control set to "1", the output is 100 mV for the IF signals and 1 mV for the RF signals.

Table 2 shows the IF Signal Output levels provided for each setting of the RF-IF RANGE and RF-IF LEVEL controls. The values listed are ideal levels delivered into a 75 ohm load.

RF-IF LEVEL SIGNAL RANGE	RF-IF LEVEL CONTROL SETTING			
	.5	1(norm)	2.5	5
Lo (1st IF)	500 µV	1000 µV	2500 µV	5000 µV
Med (2nd IF)	5000 µV	10 mV	25 mV	50 mV
Hi (3rd IF)	50 mV	100 mV	250 mV	500 mV

Table 2 - IF Signal output levels for various settings of the RF-IF RANGE and RF-IF LEVEL controls.

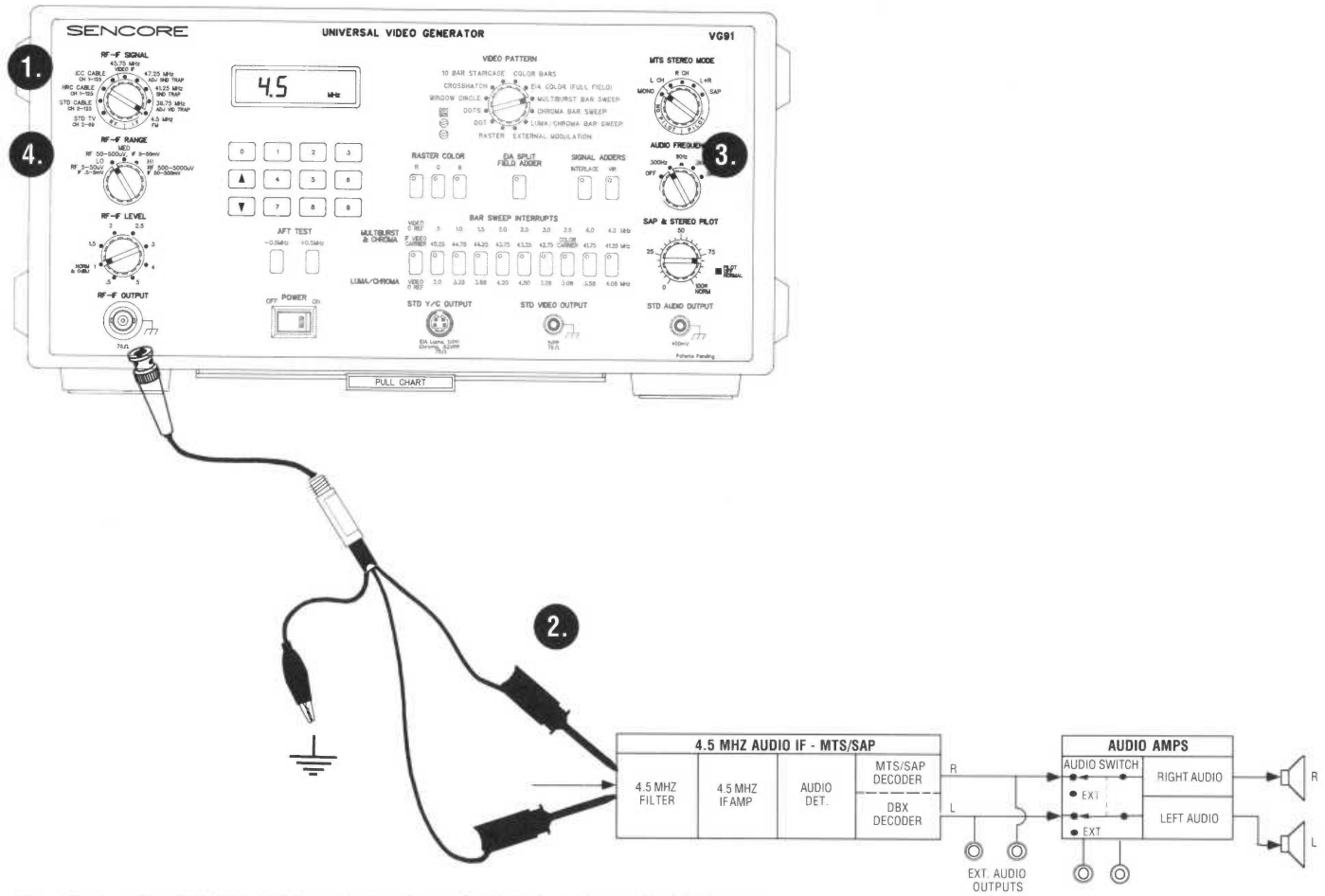


Fig. 17 - Use the 4.5 MHz FM Sound signal to substitute into the audio IF stages.

AFT Test

The AFT TEST provides a quick way to check the automatic fine tuning circuits of a televison-signal receiver. Pushing one of the momentary push-buttons shifts the carrier frequency of the selected STD TV or cable channel 0.5 MHz above or below the normal frequency. (HRC and ICC cable channels are shifted .5 MHz from the HRC or ICC shift). The RF-IF DIGITAL READOUT blinks when the button is pushed and released, but continues to display the selected channel.

Use the AFT test to check for proper AFT action and alignment. A properly working AFT circuit will correct the tuner's output to maintain good video and audio when the carrier is shifted 0.5 MHz. If the receiver fails to maintain good video and audio output, the AFT is defective or misaligned. Further information on aligning the AFT is provided in the APPLICATIONS section of this manual.

To perform the AFT Test:

1. Select the desired STD TV or Cable Channel.
2. Select the EIA Color Bars video pattern.
3. Set the RF-IF RANGE switch to "HI" and the RF-IF LEVEL control to "1".
4. Connect the RF-IF TEST CABLE to the receiver's RF or antenna input.
5. Set the receiver to the same RF channel as the VG91 and obtain a good video output on the CRT or oscilloscope connected to the video detector output or VIDEO OUT jack.
6. Push and hold the "-0.5 MHz" AFT TEST button.
7. Observe the receiver's output for good video performance. Release the "-0.5 MHz" AFT TEST button.
8. Repeat steps 6 & 7 using the "+0.5 MHz" AFT TEST button.

VIDEO PATTERNS

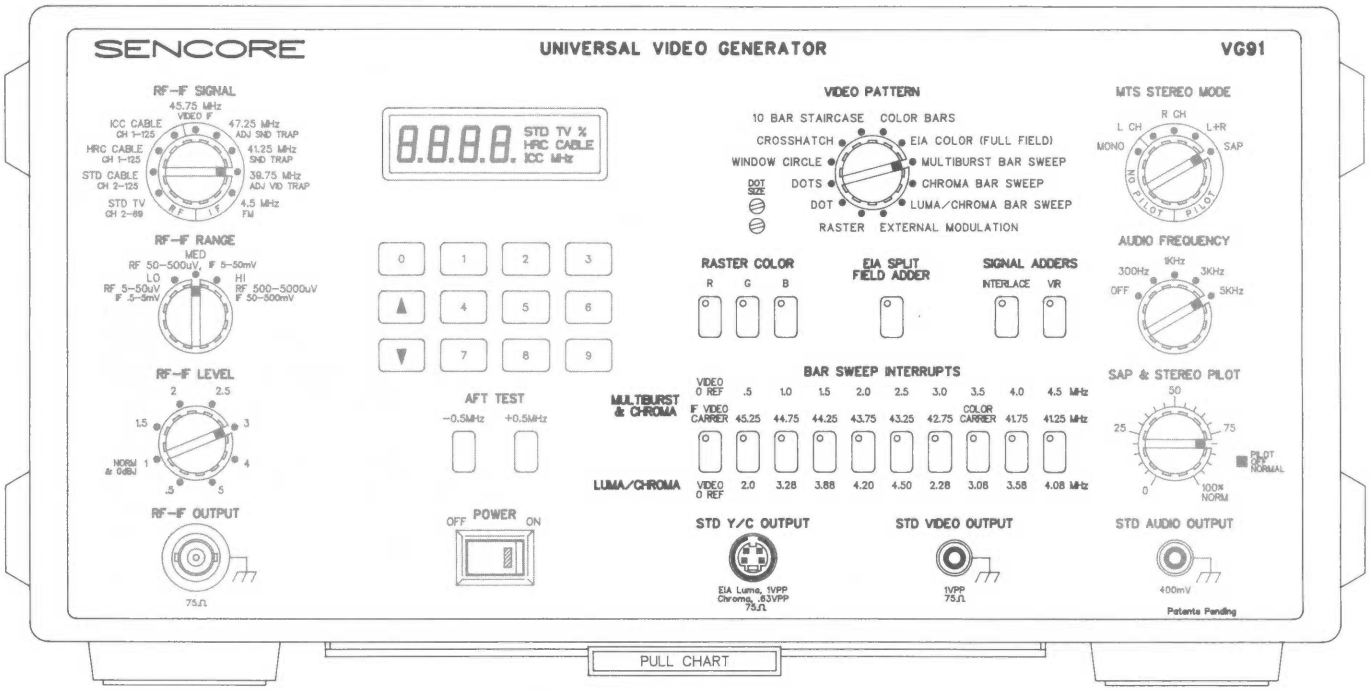


Fig. 18 - The video patterns modulate the RF and IF video carriers and feed the Y/C and STD VIDEO OUTPUT jacks.

The video pattern generator section of the VG91 produces standard test patterns and several unique analyzing patterns. Each pattern provides specific information concerning the operation, performance, and alignment of video equipment. The VIDEO PATTERN switch determines the video pattern that modulates the RF and IF video carriers and feeds the Y/C and Video Output jacks. The selected video pattern is also supplied to the Interface Accessory Jack located on the rear of the unit to feed a companion unit. Following is a brief description of each pattern and its use. The APPLICATIONS section of this manual contains additional information on using the video patterns for performance testing and alignment

Raster

The Raster pattern provides a blank raster display. The color of the blank raster can be changed from black to grey or any primary or secondary color using the RASTER COLOR switches. Activating all three RASTER COLOR switches produces an 80% level; turning off all three switches produces a black raster. Use the buttons in combination to produce a colored raster.

This pattern is used to evaluate the operation of each color gun, and to make purity adjustments in a color television receiver or monitor. For each color, the raster should be pure with no other colors visible. If the raster is not a pure color the purity needs to be adjusted.

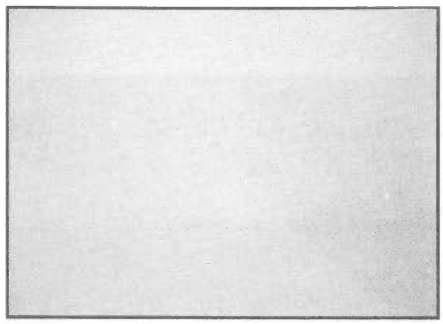


Fig. 19 - The RASTER video pattern.

Dot

The Dot pattern provides a standard single dot that is centered within the raster. This pattern is used to set the center static convergence of a color receiver or

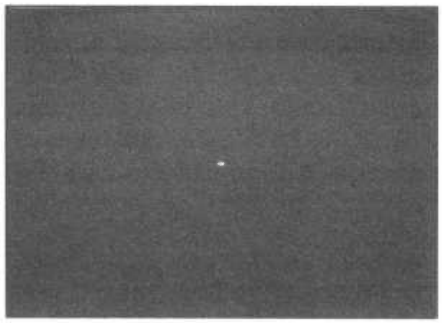


Fig. 20 - The DOT video pattern.

monitor. Static convergence is easier to set in some receivers if only a center dot is displayed. If the dot appears as three separate red, green and blue dots, instead of one white dot, the static convergence adjustments need to be set. Simply rotate the static magnets until the dot is a pure white without any color fringing. The size of the Dot is adjustable with the DOT SIZE control, and the background color can be set using the RASTER COLOR switches.

Dots

The Dots pattern provides the standard dynamic convergence pattern that is recommended by most manufacturers. The Dots pattern consists of 315 dots aligned in 15 horizontal and 21 vertical lines that are evenly spaced across the raster. The size of the dots is adjustable with the DOT SIZE control, and the background color can be set using the RASTER COLOR switches.

All of the Dots should be pure white, without any color fringing. If they aren't the dynamic convergence adjustments are set improperly. The Dots patterns also provides a test of the Video IF performance. Examine the dots carefully for any ringing or smear. If either of these conditions exist, the IF or video amplifier circuits should be further checked using the Bar Sweep patterns.

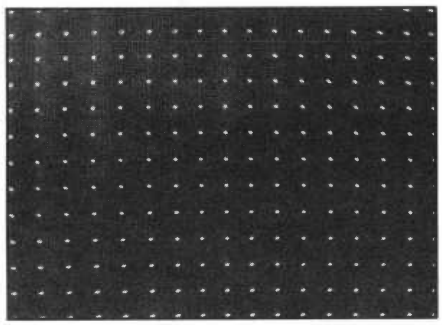


Fig. 21 - The DOTS video pattern.

Window Circle

The Window Circle pattern consists of several patterns combined into one useful pattern; a cross, a box and a circle all centered within the raster. This pattern may be used for centering, width, height, linearity, pincushion, and other defection related adjustments and tests. The size of the vertical lines is adjustable with the DOT SIZE control, and the background color can be set using the RASTER COLOR switches.

The cross marks the center of the screen. Use it to check and adjust picture centering. The top, middle and lower horizontal lines provide a convenient reference for rotating the deflection yoke. Use the box as a reference for making deflection adjustments, such as vertical height, linearity, horizontal width, and pincushion. Position the lines about 5% in from the display edges. Observe the circle when making these adjustments to maintain the best overall symmetry.

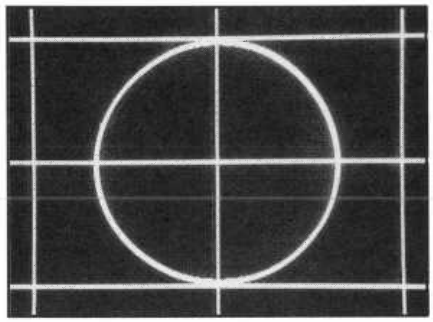


Fig. 22- The WINDOW CIRCLE video pattern.

Crosshatch

The Crosshatch pattern produces 21 vertical and 15 horizontal lines that form symmetrical squares on the screen of a properly adjusted receiver or monitor. The size of the vertical lines is adjustable with the DOT SIZE control, and the background color can be set using the RASTER COLOR switches.

This pattern is used for the entire convergence procedure on one gun CRTS that have no electronic convergence controls. The interaction between yoke positioning and the adjustments of the "4 Pole" and "6 Pole" magnets is easier to see with the Crosshatch pattern. The Crosshatch pattern can also be used in addition to the Window Circle pattern for observing overall picture linearity and making vertical and horizontal deflection adjustments. Adjust the controls for straight lines and symmetrical squares.

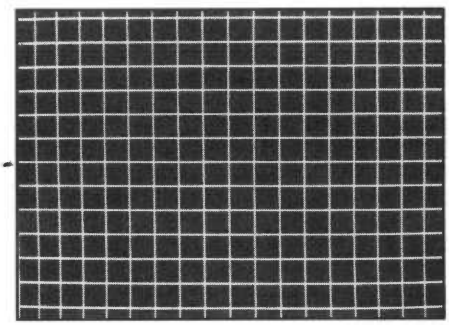


Fig. 23 - The CROSSHATCH video pattern.

Dot Size Control

The DOT SIZE control adjusts the size of the dots in the Dot and Dots video patterns and the width of the vertical lines in the Window Circle and Crosshatch patterns. It is factory aligned with white at 100 IRE units for optimum viewing on a properly adjusted receiver or monitor. If the dots or vertical lines appear too wide, check the receiver's brightness control. If the brightness control is set for correct black and white levels, adjust the DOT SIZE control until the patterns meet your preference. The adjustment control is recessed about 1/4 inch behind the front panel. Use a small, standard screw-driver or alignment tool to make the adjustment.

A CRT with weak emission may produce symptoms of thick, fuzzy lines because of its decreased ability to focus. No amount of adjustment of the DOT SIZE, and receiver Brightness controls will provide a sharp focus, although reducing the Brightness may produce a useable picture. Frequency restrictions in IF or video amplifier stages may cause the dots or vertical lines to be faint or disappear. In these cases, the defect must be repaired before the patterns can be used effectively.

10 Bar Staircase

The 10 BAR STAIRCASE pattern provides a test for proper brightness and contrast linearity, as well as for color grey scale and tracking. The pattern consists of 10 evenly-spaced bars, with video levels ranging from black to 100% white. On a properly aligned display, each bar will have an identifiable change in brightness level. An oscilloscope connected to the video detector output, or to the VIDEO OUT jack will show 10 equally-spaced steps. Unequal steps indicate linearity problems in the luminance circuits, such as a mis-aligned synchronous detector. The bars should be pure shades of gray with no hint of color. Color in any of the bars indicates the CRT setup controls are not adjusted properly.

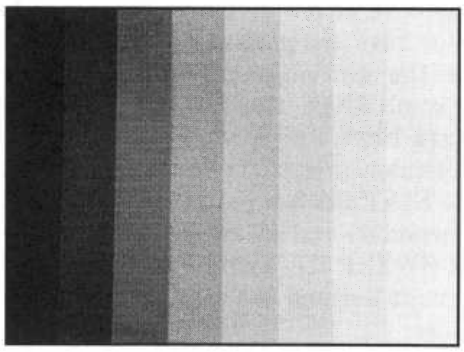


Fig. 24 - The 10 BAR STAIRCASE video Pattern.

Color Bars

The Color Bars pattern is similar to the industry accepted 10 Bar Gated Rainbow pattern that has been used for many years by video technicians for color circuit troubleshooting and alignment. Each color bar represents a phase shift of approximately 30 degrees, resulting in 10 visible bars of different color hues on a properly working color receiver or monitor. (2 bars occur during blanking time).

Three improvements to the VG91's COLOR BARS pattern compared to conventional color bar generators insures proper performance with today's color circuits: 1) a true color burst at the proper phase, amplitude and location on the back porch of horizontal sync; 2) the color information is phase-locked to the horizontal sync for proper detection by comb filters; and 3) the color information is at a 100% saturated level.

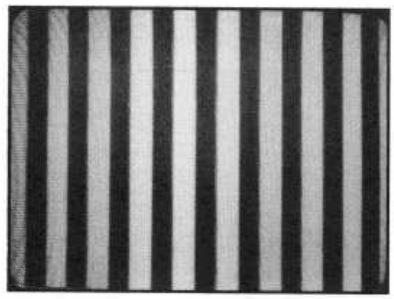


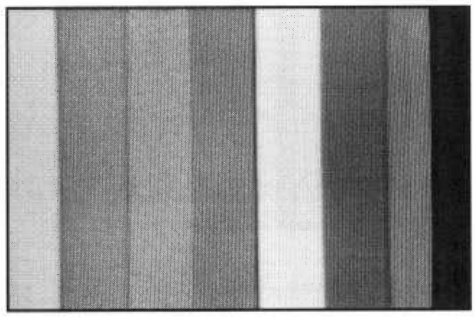
Fig. 25 - The COLOR BARS video pattern.

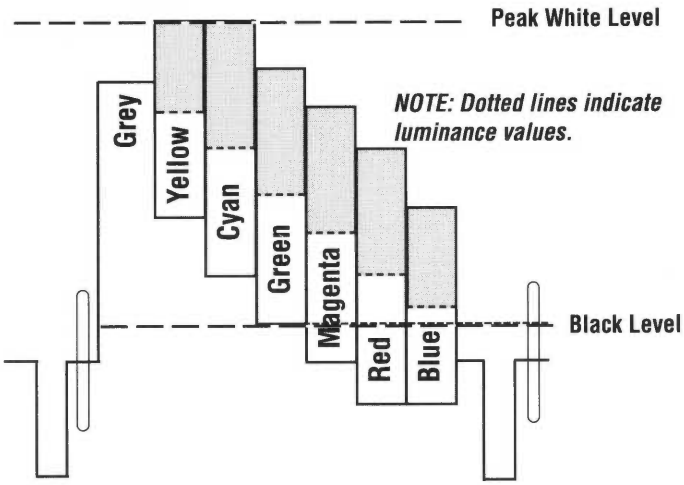
EIA Color (Full Field)

The EIA COLOR bars pattern meets the industry-standard color pattern specified by manufacturers for testing color processing circuits in VCRs, camcorders, television receivers and other video equipment. The EIA COLOR pattern can be used with a conventional vectorscope and waveform monitor to analyze the relative amplitudes and phase of the color signals.

The bars in this pattern consist of two distinct amplitude portions - luminance (brightness) and color level (saturation), as shown in figure 26. The luminance portion of the signal forms an uneven, seven-level stairstep. The color saturation is 75%, which brings the top of the yellow and cyan bars to the 100% white level. Refer to the APPLICATIONS portion of this manual for more information on how to use this pattern with a waveform monitor and vectorscope to make luminance and chroma circuit adjustments.

Fig. 26 - The EIA Color (Full Field) pattern.





Multiburst Bar Sweep

The Multiburst Bar Sweep pattern consists of ten, reference frequency bars beginning with a solid white "0 MHz" reference bar, and increasing in .5 MHz steps to 4.5 MHz. The individual bars can be turned on and off with the BAR SWEEP INTERRUPTS buttons. When all the interrupt buttons are off, a black raster is produced.

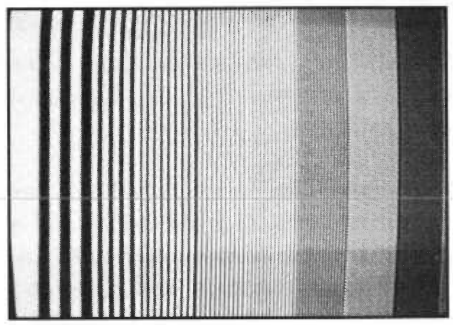


Fig. 27 - The MULTIBURST BAR SWEEP video pattern.

The Multiburst Bar Sweep pattern isolates frequency response problems in video IFs, comb filters and luminance processing circuits. The pattern can also be used to align video IF stages for the best overall frequency response and gain with minimum picture distortion. Each bar is generated with the same amplitude and luminance phase to provide a dynamic test of the video stages through the entire range of video frequencies. A video stage that has a limited frequency response will reduce the amplitude or distort the shape of one, or several bars. Adjust the circuit for the highest amplitude at the luminance output of a comb filter, or for the best detail on the CRT.

Chroma Bar Sweep

The Chroma Bar Sweep pattern isolates stages which may be restricting the band of color signals needed for good color reproduction. The pattern consists of three frequency bars at 3.0 MHz, 3.5 MHz, 4.0 MHz. All three color bars are phased as chroma, and should appear at the color output of a properly aligned and working comb filter. The left and right sides of the pattern are 100% white, while the 3.58 MHz center bar is 75% color saturated cyan and matches the cyan bar of the EIA Color bar pattern. The individual bars can be turned on and off for easy identification with the BAR SWEEP INTERRUPTS buttons. When all the interrupt buttons are off, the full raster will be 100% white.

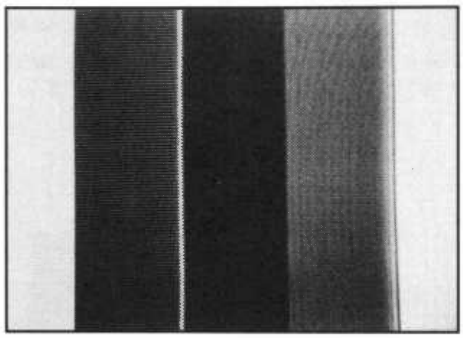


Fig. 28 - The CHROMA BAR SWEEP video pattern.

The Chroma Bar Sweep pattern isolates chroma response problems in IF, comb filters, and chroma processing circuits. The three bars of the Chroma Bar Sweep pattern are output from the VG91 at approximately the same level. A stage that is restricting the 1 MHz band of chroma signals will reduce the amplitude of one or more of the bars. Adjust the circuit for the highest amplitude at the chroma output of a comb filter, or for the most visible stripes on the CRT.

Luma/Chroma Bar Sweep

The Luma/Chroma Bar Sweep pattern provides an important performance test of today's high performance, wideband video circuits that use comb filters, wideband chroma decoders or separate luminance and chroma signal inputs. This pattern differs from the Multiburst Bar Sweep and Chroma Bar Sweep patterns in two ways. First, the luminance and chroma frequency response test information is combined into a single pattern that easily shows problems with Y/C separation. Secondly, the frequency range of the color bars is extended to test wideband I color circuits.

The numbers on the front panel located below the BAR SWEEP INTERRUPT switches indicate the video frequency of each bar. The six luminance-phase bars (0 MHz reference white, 2.0 MHz, 3.28 MHz, 3.88 MHz, 4.2 MHz and 4.5 MHz) should appear as B&W only on the CRT. Located to the right of the B&W luminance bars on the raster, are the chroma-phased bars (2.28 MHz, 3.08 MHz, 3.58 MHz and 4.08 MHz). You should see color stripes in each of these bars if the wideband color circuits are properly aligned and operating.

Note: The frequencies of the color bars fall within the frequencies of the luminance bars. This overlap is the region of the video signal where the color and luminance signals are interleaved. Color rainbowing or "barberpoling" in the luminance bars indicates that some of the chroma information has not been separated from the luminance.

Note: The amount of color interference in the luminance signal varies by chassis. Some color rainbowing may be normal, even when the circuits are properly aligned.

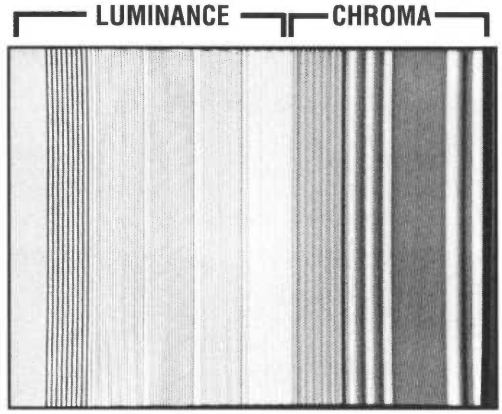


Fig. 29 - The Luma/Chroma Bar Sweep video pattern.

As with the Chroma Bar Sweep pattern, the 3.58 MHz bar is 75% color saturated cyan. The individual bars can be turned on and off for easy identification with the BAR SWEEP INTERRUPTS buttons. When all the interrupt buttons are off, the full raster will be black.

Bar Sweep Interrupts

The BAR SWEEP INTERRUPTS switches allow you to turn on and off individual bars of the Multiburst Bar Sweep, Chroma Bar Sweep, and Luma/Chroma Bar Sweep video patterns. This is useful for easily identifying a particular frequency. When one of the bar sweep patterns is initially selected, all of the individual bars are active and the LEDs of the corresponding interrupt switches are illuminated. Press the Bar Sweep Interrupt switch to turn the corresponding bar off and on. Any bar(s) that you have turned off for a pattern will remain off when you return back to the pattern after having selected a different video pattern.

Note: Only the 3.0. 3.5 and 4.0 MHz bars can be activated in the Chroma Bar Sweep pattern.

The numbers shown on the front panel above and below the BAR SWEEP INTERRUPT switches indicate the video, chroma, and IF frequencies generated by the video patterns. The top row of numbers indicates the composite video frequencies when the Multiburst Bar Sweep and Chroma Bar Sweep patterns are selected. The row just above the push-buttons indicates the equivalent IF sideband frequencies produced by the receiver when these patterns are selected. The values below the switches indicate the video frequencies generated in the receiver when the Luma/Chroma Bar Sweep pattern is selected.

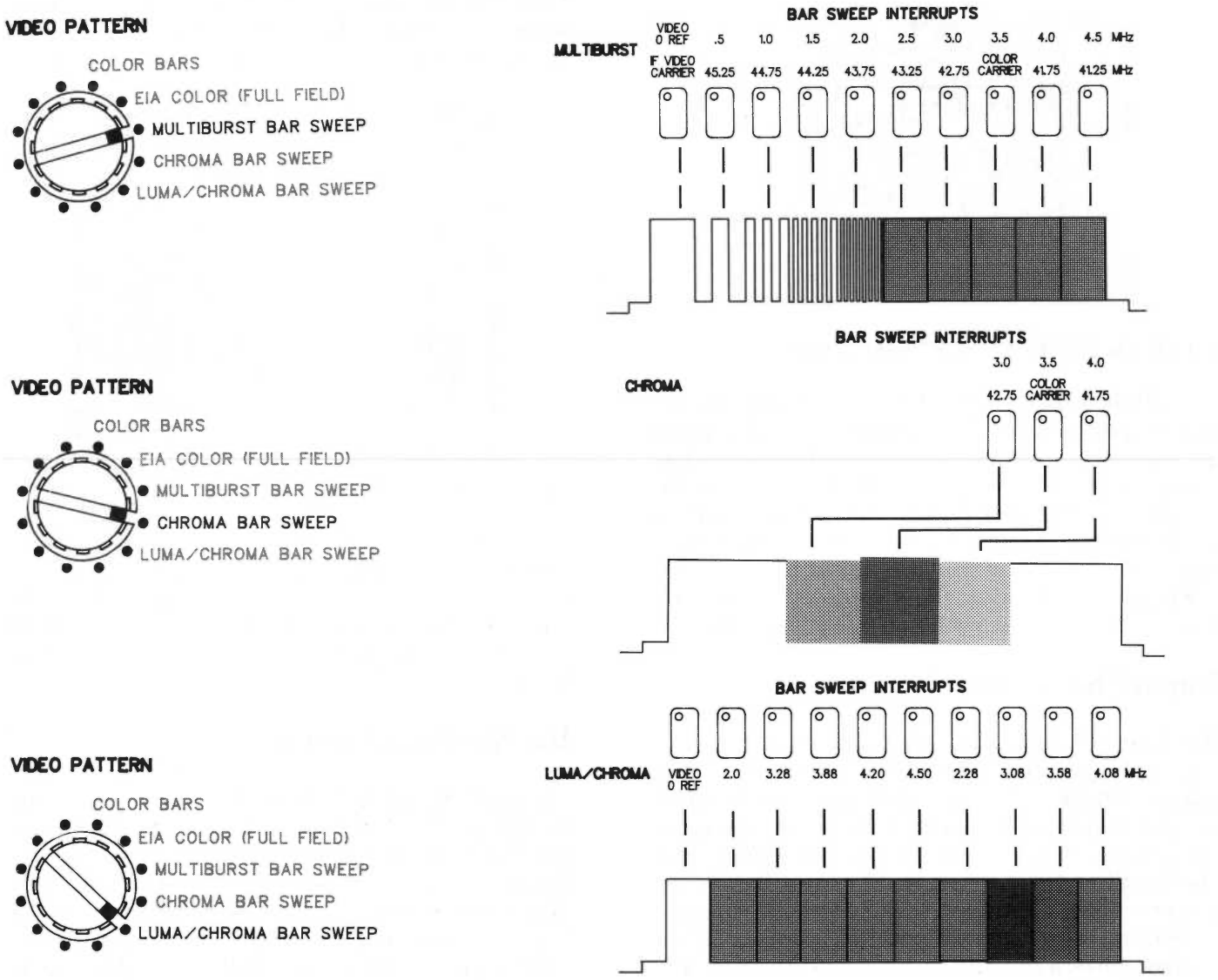


Fig. 30 - Use the Bar Sweep Interrupt switches to turn the individual bars of the Multiburst, Chroma, and Luma/Chroma Bar Sweep patterns on and off. The corresponding video and IF frequencies are indicated.

Raster Color Switches

The RASTER COLOR switches select the background color when the Raster, Dot, Dots, Window Circle, and Crosshatch patterns are selected. The colors available are grey and any of the primary and secondary colors. The selected background color will be the same for all patterns, and will remain the color you set it to if you switch to a different pattern and then back. The background color resets to black when the VG91's AC POWER is turned off.

The RASTER COLOR switches also add and delete colors and color combinations to the EIA Color pattern. This provides the added capability to include one color or any combination of colors desired for analyzing chroma processing or decoding circuits. The EIA Color will remain as you set it if you switch to a different pattern and back. Turning the AC POWER off resets the pattern.

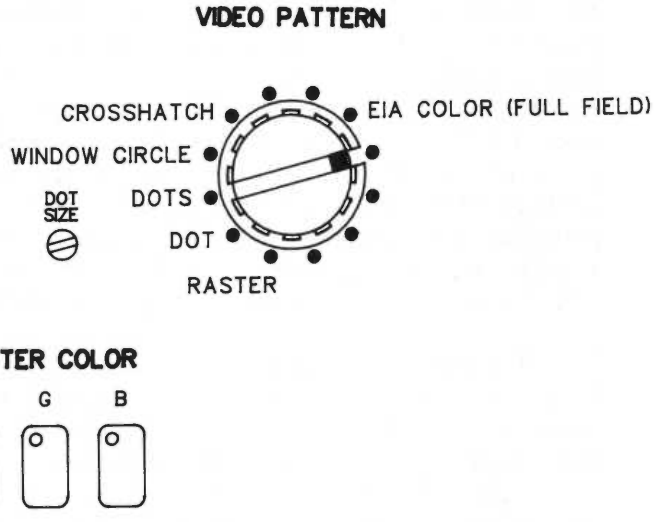


Fig. 31 - The RASTER COLOR switches select any combination of primary, or secondary colors to the RASTER, DOT, DOTS, WINDOW CIRCLE, CROSSHATCH and EIA COLOR video patterns.

EIA Split Field Adder

The EIA SPLIT FIELD ADDER switch adds special test signals to the bottom quarter of the screen when the EIA COLOR video pattern is selected. This produces the standard EIA Split Field Color Bar pattern, which conforms to industry recommendations for some video servicing applications.

The split-field pattern is identical to the full field pattern for the top three-quarters of the screen. The bottom quarter of the screen includes a -I, white, Q and black signals. The right half of the bottom area is pure black, the white bar is 100% white, and the I and Q signals are samples of the chroma subcarriers.

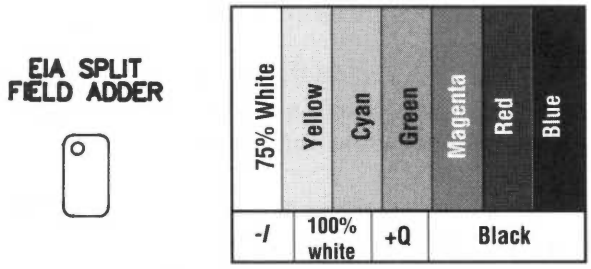


Fig. 32 - The EIA SPLIT FIELD ADDER switch changes the EIA Color (Full Field) video pattern to the EIA Split-Field video pattern.

Signal Adders

The video patterns produced by the VG91 may be modified using the SIGNAL ADDERS switches. These switches allow you to add INTERLACE and VIR to any of the VG91's video patterns and video output signals. The adder is active when the LED in the corresponding switch is lit.

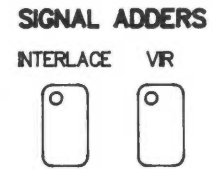


Fig. 33 - The SIGNAL ADDERS buttons add Interlace sync and VIR to any of the internal video patterns.

Interlace Adder

The INTERLACE ADDER switch allows you to add vertical sync interlace to any of the video patterns generated by the VG91. When the INTERLACE ADDER switch is enabled (LED on) the video patterns will be interlaced; when the switch is disabled (light off) the video patterns are non-interlaced.

Interlaced signals include serrations and equalizing pulses in vertical sync that duplicate standard, NTSC broadcast signals. Interlaced signals also add an extra half-line of horizontal information per field. This causes a visible jitter when using a stationary test pattern. Non-interlaced signals delete the serrations, equalizing pulses and extra half line, and duplicate signal sources such as cameras, VCRs, or video games. Select non-interlace when using the test patterns to eliminate the half-line jitter.

You should select between non-interlaced and interlaced video when performance testing video equipment to test the vertical countdown circuits. Vertical countdown circuits switch operating modes depending if the signal source is interlaced, as from a broadcast or cable station, or non-interlaced, as from a VCR or video game. If the countdown circuits do not switch properly between modes, the picture will roll vertically when one or the other signal sources is applied.

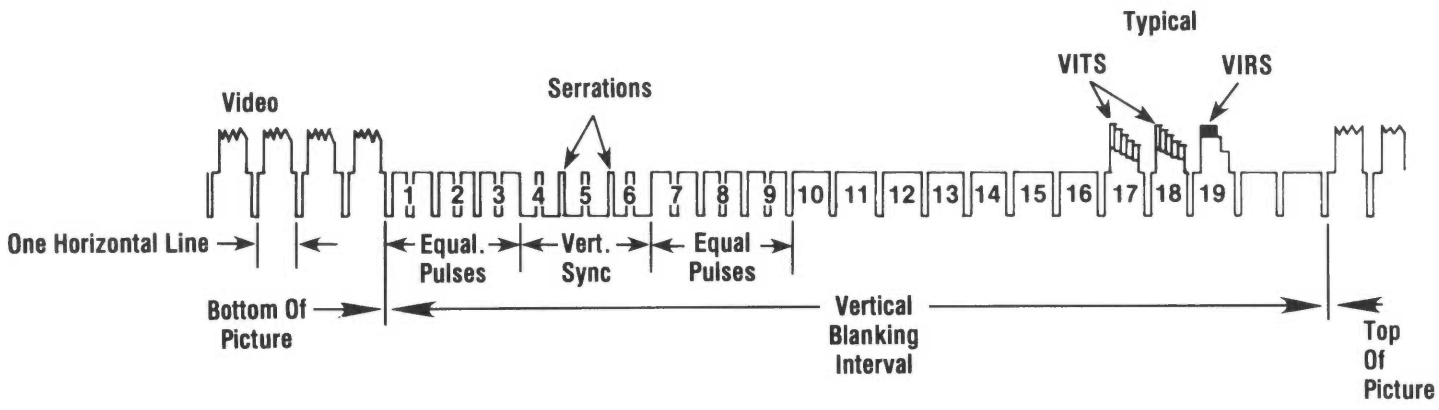


Fig. 34 - An interlaced signal adds equalizing pulses, and serrations to the vertical sync pulse, as well as an extra one-half line.

NOTES: 1) The INTERLACE ADDER does not operate with the VIDEO PATTERN set to "External Modulation". The VG91's sync interlace will be determined by the applied signal. 2) Connecting the CHROMA LOCK OUTPUT of the VC93 to the CHROMA LOCK input of the VG91, phase locks the VG91 to the VC93 and VCR and overrides the INTERLACE ADDER switch.

VIR Adder

The VIR ADDER inserts a standard VIR (Vertical Interval Reference) signal to line 19 of the vertical interval. Some receivers use the VIR signal for automatic color saturation and tint control. The VIR can be added to any of the VG91's internally generated video patterns. See Appendix D.

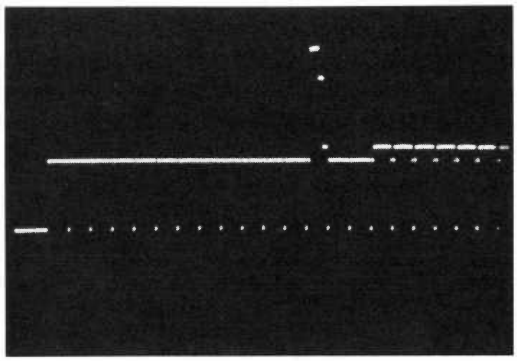


Fig. 35 - The VIR adder inserts a standard VIR signal.

Standard Y/C And Video Outputs

The STD Y/C and STD VIDEO output jacks of the VG91 match all standard Y/C or composite video inputs found on consumer and most professional video equipment. The video signal is selected by the VIDEO PATTERN switch. The STD Y/C OUTPUT provides the separate luminance and chroma portions of the composite video signal for testing S-Video inputs. The STD VIDEO OUTPUT provides a composite video signal at the proper level and impedance to match the standard Video Inputs found on video monitors, VCRs, cable modulators, video distribution amplifiers, video processors, etc.

Note: There is no output from the STD Y/C OUTPUT Jack when the VIDEO PATTERN switch is set to "External Modulation."

Note: The STD Y/C OUTPUT and STD VIDEO OUTPUT must be properly terminated with 75 ohms for proper operation and output levels.

The frequency response of both outputs is flat through the entire 4.5 MHz bandwidth of the video patterns. This enables you to accurately test the response of high resolution video systems.

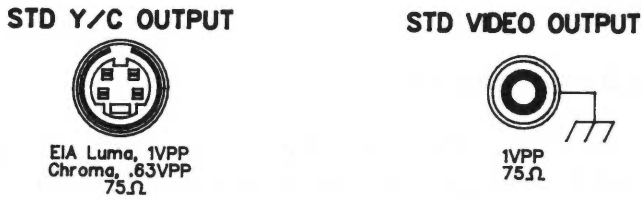


Fig. 36 - The STD Y/C and STD VIDEO OUTPUTS match standard Y/C or video inputs. The video is selected by the VIDEO PATTERN switch.

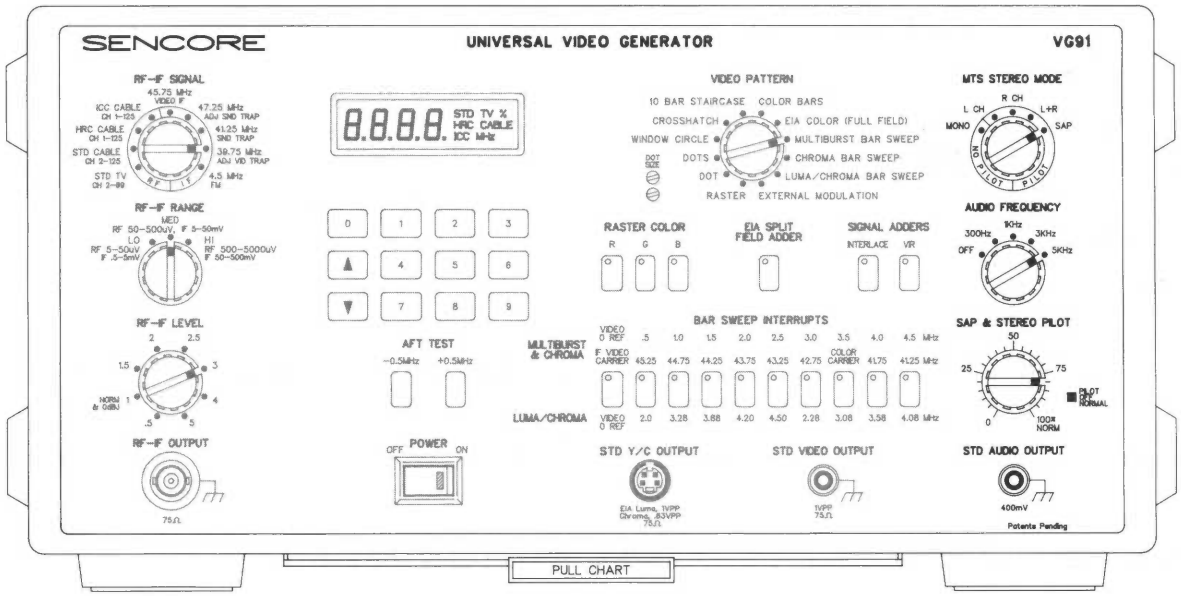


Fig. 37 - The MTS/Audio generator provides modulation for the RF, IF and trap signals as well as an audio out signal.

The MTS audio generator section of the VG91 provides both standard audio and MTS stereo signals for testing and troubleshooting monaural and MTS stereo television-signal receivers. The audio generator has three main functions: 1) It provides modulation for the RF and IF signals with the selected audio frequency and composite stereo mode; 2) It amplitude modulates the IF trap carriers to provide improved resolution when performing IF trap alignment, and 3) It provides an audio frequency signal to apply standard audio input connectors.

RF-IF Audio Modulation

A modulated audio carrier can be applied to any of the STD TV or Cable channels, the 45.75 MHz video IF signal or the 4.5 MHz IF signal using the MTS STEREO MODE and AUDIO FREQUENCY switches. When the MTS STEREO MODE switch is set to "Mono" and the AUDIO FREQUENCY switch is set to "Off", the aural carrier is totally removed from the RF channels and IF signals. If either control is moved from these positions, an aural carrier will be added to the RF or IF video signal. The capability to remove the aural carrier, adds versatility to troubleshooting and video alignments.

Note: Because the MTS signal includes a pilot signal, the MTS MODE SWITCH must be set to "Mono" if no audio carrier is desired. To generate an unmodulated aural carrier, set the AUDIO FREQUENCY switch to "Off", set the SAP & STEREO PILOT to "0" and select any of the blue "Pilot" positions of the MTS STEREO MODE switch.

Note: When the aural carrier is removed from the RF or IF carrier, an increase in noise in the 4.0 to 4.5 MHz bars of the Multiburst Bar Sweep or Luma / Chroma Bar Sweep patterns may occur.

Selecting Mono or MTS Stereo Signals

The VG91 provides all of the MTS modulation mode (composite) signals needed to performance test and troubleshoot MTS stereo decoders. The composite audio signal, as determined by the MTS STEREO MODE switch, modulates the aural carrier. The switch has a multi-colored band. The signal in the grey band (NO PILOT), provides a mono only (main channel) signal without a pilot. This is the same as standard, monaural audio. The four switch positions in the blue band (PILOT), modulate the audio carrier with the appropriate MTS sub-channel, SAP, and pilot signals.

L CH & R CH - The "L CH" and "R CH" positions modulate the carrier so that an audio output occurs in the corresponding channel. Use these positions for testing stereo separation.

L+R - The "L+R" position produces equal output in both the left and right audio channels. Use this position for testing overall stereo operation.

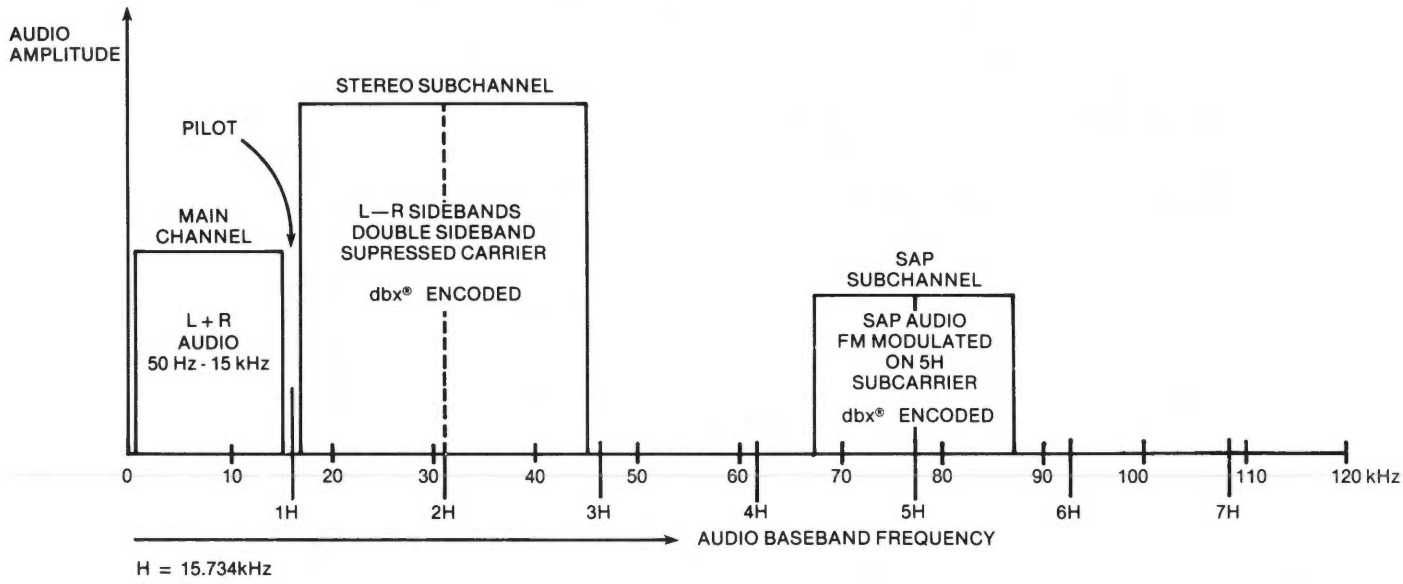


Fig. 38 - The VG91 selects between Mono, MTS stereo, or SAP signals to modulate the RF or IF aural carrier.

SAP - The SAP position produces an audio output in only the SAP channel. Use this position for checking SAP operation.

Sap & Stereo Pilot Adjust

The SAP & STEREO PILOT control adjusts the modulation level of the 1H pilot signal in the Stereo positions of the MTS STEREO MODE switch. When the "SAP" mode is selected, the SAP & STEREO PILOT control adjusts the modulation level of the SAP carrier. The variable stereo pilot and SAP levels are used to check the stereo and SAP detection circuits for proper switching threshold. For most tests, the SAP & STEREO PILOT control should be set to 100% which produces normal pilot and SAP signals. The PILOT OFF NORMAL light, located near the "Norm" position of the SAP & STEREO PILOT control, provides a visual reminder that the level has been reduced from normal.

Audio Frequencies

The AUDIO FREQUENCY switch determines the audio tone that modulates the audio carriers, as well as the audio signal that is available at the STD AUDIO OUTPUT jack. The four audio tones provide the necessary frequency selections to check the frequency response of the audio processing circuits and MTS decoders.

The audio tones are also used to amplitude modulate the interference carrier when one of the IF Trap signals is selected. The interfering carrier can be unmodulated ("Off" position), or modulated with any of the four frequencies selected by the AUDIO FREQUENCY switch. The modulation creates sideband signals that improve the visibility of the interference on a CRT or scope when making trap adjustments.

STD Audio Output

The STD AUDIO output of the VG91 provides a standard, baseband audio signal to apply to a standard AUDIO IN connector. The frequency of the audio output is selected by the AUDIO FREQUENCY switch. The output provides the proper level to match standard audio inputs found on VCRs, TV receiver/monitors and other electronic products. Use an RCA phono Tee adapter (not supplied) to split the signal to the left and right inputs of stereo units. The signal at the output jack is independent of the setting of the MTS STEREO MODE control.

COMPUTER AUTOMATED BUS OPERATION

The VG91 Universal Video Generator can be used for computer controlled automated testing. A simple computer program can be developed to automatically set up any of the front panel controls (except the AFT TEST buttons and POWER switch). The VG91 can be used with either the IEEE-488 Bus and the Sencore IB72 accessory, or the RS232 Bus and the Sencore IB78 accessory. Both accessories connect to the INTERFACE ACCESSORY JACK located on the rear of the VG91.

Note: When using the VG91 with the IB72 IEEE-488 Bus Interface, check the version number of EPROM IC4 in the IB72. If your IB72 has version 2.0, contact the Sencore Service Department for a replacement.

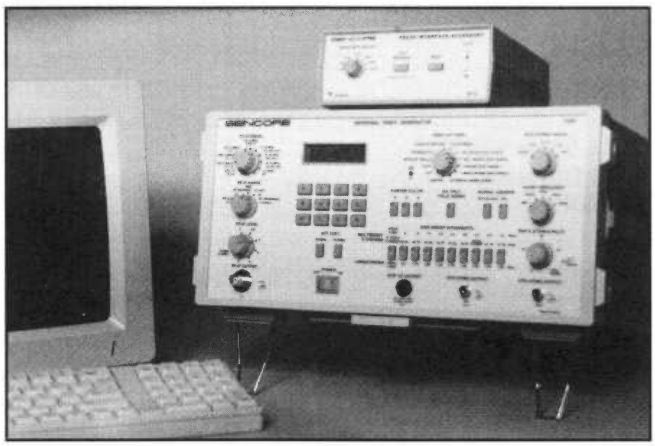


Figure 39 - The VG91 can be used for automatic testing by connecting an Interface Accessory and a computer or controller

The VG91 can be used as either a Talker or a Listener. When the VG91 is in the listener mode, the computer can set the VG91's front panel controls over the interface bus. The computer can automatically select RF-IF signals, TV channels, RF-IF output levels, video patterns, and MTS audio signals.

Note: The VG91 AFT TEST buttons can not be controlled by the computer.

The VG91 can also be used in the Talker mode. As a Talker, the VG91 will send all its front panel settings to the computer when it receives the correct command.

Connecting The VG91 To The Interface Bus

The VG91 produces a special Sencore formatted signal which must be translated by a Sencore Interface Accessory before it can be placed on the bus. The Interface Accessory is connected in series with the controller and the VG91. A standard cable connects the controller to the Interface Accessory.

WARNING

Only connect the Sencore Interface Bus accessories to the INTERFACE ACCESSORY JACK on the rear of the VG91. Do not connect any other instruments or interface bus equipment to the VG91, even if the connectors fit.

When using the VG91 with an IEEE-488 automated bus system, it must be assigned an address that is separate from the other products on the system. This allows the controller to select which instrument it is talking or listening to. Refer to the instructions provided with the IB72 for more details on setting the address, and for additional connection information. A special address is not needed when using the IB78 RS232 Interface Bus Accessory.

To connect the VG91 to an automated test system:

1. Remove the power from the VG91, the Interface Accessory and the computer/controller.

2. Set the slide switches on the rear of the IB72 IEEE-488 Bus Interface Accessory for the proper address that is desired for the VG91. This step is not needed with the IB78.

3. Connect the interface accessory's male DIN connector to the INTERFACE ACCESSORY JACK located on the rear of the VG91.

4. Connect the proper cable from the Interface Accessory to the computer.

5. Supply power to all units in the automated system and verify that all units are on.

WARNING

Do not apply power to the VG91 or interface accessory until all connections have been made.

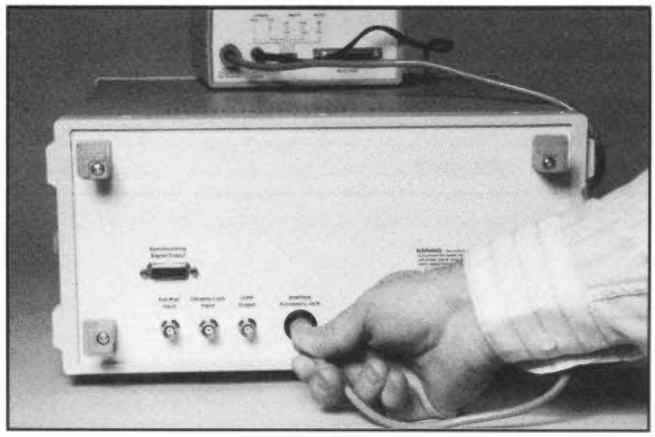


Fig. 40 - The IB72 or IB78 connect to the INTERFACE ACCESSORY Jack on the rear of the VG91.

Using The VG91 As A Listener

The main operation of the VG91 in an automated test system is as a listener. As a listener, the settings of the front panel controls can be automatically set with a computer to pre-determined conditions. This can be especially useful as an aid in performance testing, as the computer can prompt a non-technical person through the test.

The first valid bus command received by the VG91 "locks out" the front panel controls and the VG91 responds only to bus commands. All of the front panel controls remain locked out until a "CPO" (control panel on) command is received from the controller. The VG91 functions the same under bus control as it does during manual control, and the digital meter continues to display the RF-TV Channel or selected IF signal.

Command Descriptions

The VG91 uses a series of commands to control the front panel setup. The entire command must be sent in order for the VG91 to properly respond. Table 3 summarizes the control commands recognized by the VG91. Table 5 includes a brief description of each command.

SETUP (Listen)

RF Channels	
STD TV (2-69)	STDxx
STD Cable (2-125)	STCxxx
HRC Cable (1-125)	HRCxxx
ICC Cable (1-125)	ICCxxx
Channel up	CHUP
Channel down	CHDN
IF & Trap Signals	
45.75 MHz Video IF	IF45.75
47.25 MHz trap	TR47.25
41.25 MHz trap	TR41.25
39.75 MHz trap	TR39.75
4.5 MHz sound IF	FM4.5
RF-IF Levels	
LO Range	RILEVLO
MED Range	RILEVMED
HI Range	RILEVHI
Level vernier setting	RIVERxxx
Video Patterns	
Raster	VPATRAS xxx
Dot.	VPATDOT
Dots	VPATDTS
Window Circle	VPATWINCR
Crosshatch	VPATCRH
10 Bar Staircase	VPATSTR
Color Bars	VPATCLB
EIA Color (Full Field)	VPATEIA
Multiburst Bar Sweep	VPATMBR xxxxxxxxxx
Chroma Bar Sweep	VPATCBR xxx
Luma/Chroma Bar Sweep	VPATLCBR xxxxxxxxxxx
External Modulation	VPATEXT
Dot Size set	DSIZExxx
EIA Color Split field	EIASF x
Interlace Adder	INT x
VIR Adder	VIR x
Background raster color	RAS xxx
MTS Stereo Mode	
Mono	AMODMONO
L CH	AMODL
R CH	AMODR
L + R	AMODL+R
SAP	AMODSAP
SAP & Stereo Pilot level	PLEVxxx
Audio Frequency	
audio off	AFOFF
300 Hz	AF300HZ
1 kHz	AF1KHZ
3 kHz	AF3KHZ
5 kHz	AF5KHZ
General	
Control Panel On	CPO

LEARN (Talker)

RF-IF Signals	
RF-IF Signal	CPSRISIG
RF channel	CPSCH
RF-IF Range	CPSRILEV
RF-IF Level	CPSRIVER
Video Patterns	
Video pattern	CPSVPAT
Dot Size	CPSDSIZE
Raster colors	CPSRAS
Split Field Adder on/off?	CPSSF
Interlace Adder on/off?	CPSINT
VIR Adder on/off?	CPSVIR
MTS Stereo & Audio	
Stereo Mode	CPSAMOD
Audio frequency	CPSAF
SAP & Stereo Pilot Level	CPSPLEV
General	
All front panel settings.	CPSALL

Table 3 - List of commands acknowledged by the VG91.

Learn Commands: (Talker mode)

These commands are used by the controller to learn the settings of the VG91. You can preset the VG91 before turning it over to bus control. These commands are also used if you want to store the settings for future comparison or reference.

RF-IF SIGNALS

CPSRISIG - Returns the setting of the RF-IF SIGNAL control.

CPSCH - Returns the RF channel

CPSRILEV - Returns the setting of the RF-IF RANGE control.

CPSRIVER - Returns the setting of the RF-IF LEVEL control with a 3-digit number between 0.50 and 5.00

VIDEO PATTERNS

CPSVPAT - Returns the setting of the VIDEO PATTERN switch.

CPSDSIZE - Returns a number between 0 and 255 corresponding to the setting of the DOT SIZE control; 0 = smallest size, 255 = largest size.

CPSRAS - Returns the setting of the RASTER COLOR switches in the form xxx corresponding to R, G and B, where x is either 1 (color switch on) or 0 (color switch off).

CPSSF - Returns the setting of the EIA SPLIT FIELD ADDER button; on or off.

CPSINT - Returns the setting of the INTERLACE SIGNAL ADDER; on or off.

CPSVIR - Returns the setting of the VIR SIGNAL ADDER button; on or off.

MTS STEREO & AUDIO TALKER COMMANDS

CPSAMOD - Returns the setting of the MTS STEREO MODE switch.

CPSAF - Returns the setting of the AUDIO FREQUENCY switch.

CPSPLEV - Returns a number from 0 to 100 (%) indicating the setting of the SAP & STEREO PILOT control.

GENERAL TALKER COMMAND

CPSALL - This command tells the VG91 to send the settings of all front panel controls over the bus. Returns thirteen lines of information.

Table 4 - List of Learn Commands for the VG91.

Listen Commands

These commands are sent by the controller to change the settings of the VG91 controls. The switch indicator LED and channel display will continue to operate as in manual operation.

RF CHANNEL LISTENER COMMANDS

STD xx - Select STD TV channel where xx is a 1 or 2 digit number between 2 and 69.

STC xxx - Select STD cable channel where xxx is a 1, 2, or 3 digit number between 2 and 125.

HRC xxx - Select HRC shifted cable channel where xxx is a 1, 2, or 3 digit number between 1 and 125.

ICC xxx - Select ICC shifted cable channel where xxx is a 1, 2, or 3 digit number between 1 and 125.

CHUP - Increment the current channel number by one. The channel number wraps around at 69 for STD TV, and 125 for the Cable channels.

CHDN - Decrement the current channel number by one. Numbers below 2 wraps around to 69 for STD TV, and 125 for Cable channels.

IF & TRAP SIGNAL LISTENER COMMANDS

IF45.75 - Select 45.75 MHz Video IF.

TR47.25 - Select 47.25 MHz Adj SND Trap.

TR41.25 - Select 41.25 MHz SND Trap.

TR39.75 - Select 39.75 MHz Adj Vid Trap.

FM4.5 - Select 4.5 MHz sound IF.

RF-IF LEVEL LISTENER COMMANDS

RILEVLO - Select "Lo" RF-IF RANGE.

RILEVMED - Select "Med" RF-IF RANGE.

RILEVHI - Select "Hi" RF-IF RANGE.

RIVER xxx - Sets RF-IF LEVEL where xxx is a number between .5 and 5.00 in .01 steps. Leading and place holder "0's" are optional.

VIDEO PATTERN LISTENER COMMANDS

VPATRAS xxx - Select Raster pattern. The RASTER COLOR switches are set by variable xxx corresponding to R,G,B, where x is 1 (color on) or 0 (color off).

VPATDOT - Select Dot pattern.

VPATDTS - Selects Dots pattern.

VPATWINCR - Selects Window Circle pattern..

VPATCRH - Selects Crosshatch pattern.

VPATSTR - Selects 10 Bar Staircase pattern.

VPATCLB - Selects Color Bars pattern.

VPATEIA - Selects EIA Color (Full Field) pattern.

VPATMBR xxxxxxxxxx - Selects Multiburst Bar Sweep pattern. Each position of the variable controls the corresponding Bar Sweep Interrupt button, where x is 1 (bar on) or 0 (bar off).

VPATCBR xxx - Selects Chroma Bar Sweep pattern. Each position of the variable controls the corresponding Bar Sweep Interrupt button, where x is 1 (bar on) or 0 (bar off).

VPATLCBR xxxxxxxxxx - Selects Luma/Chroma Bar Sweep pattern. Each position of the variable controls the corresponding Bar Sweep Interrupt button, where x is 1 (bar on) or 0 (bar off).

VPATEXT - Select External Modulation position of VIDEO PATTERN switch.

DSIZE xxx - Set Dot Size, where xxx is a number between 0 (smallest size) and 255 (largest size).

EIASF x - Turn EIA SPLIT FIELD ADDER button on (x=1) or off (x=0).

INT x - Turn INTERLACE SIGNAL ADDER button on (x=1) or off (x=0).

VIR x - Turn VIR SIGNAL ADDER button on (x=1) or off (x=0).

RAS xxx - Set RASTER COLOR switches, where the variable corresponds to R, G, and B (1=color on, 0=color off)

MTS STEREO MODE LISTENER COMMANDS

AMODMONO - Select Mono mode.

AMODL - Select L CH. mode.

AMOR - Select R CH mode.

AMODL+R - Select L + R mode.

AMODSAP - Select SAP mode.

PLEV xxx - Set SAP & Stereo Pilot level with variable representing the percent of modulation between 0 and 100.

AUDIO FREQUENCY LISTENER COMMANDS

AFOFF - Select audio off.

AF300HZ - Select 300 Hz audio frequency.

AF1KHZ - Select 1 kHz audio frequency.

AF3KHZ - Select 3 kHz audio frequency.

AF5KHZ - Select 5 kHz audio frequency.

Table 5 - List of Listen Commands for the VG91.

Data Returned by the VG91 in Talker Mode

In the talker mode, the VG91 continually returns data to the computer regarding the setting of the front panel controls. The front panel controls can be read all at once, or individually. Sending an individual function command (see Table 5) instructs the VG91 to return the setting of only that control. The "CPS ALL" command instructs the VG91 to return the settings of all the front panel controls. If you send the CPS ALL command, your controller must be able to receive 13 data fields, one after another, with a carriage return and line feed between them.

The data returned by the VG91 is in a standard data format, as shown in Table 6. Each data string is 25 characters long. The data string consists of three parts; 1) Header, 2) Data field, and 3) End terminator. Each part has the same number of characters for any function, allowing you to use the same subroutines to process any returned data.

The following are the details of the data returned by the VG91 along with several examples.

(1) Header: Characters 0-4 identify the VG91 control that is being read by the data sent to the computer.

(2) Data: The characters that follow the header contain the positions, values, and other data regarding the front panel control.

(3) End Terminator: Character 23 is a carriage return (ASCII decimal 13) and character 24 is a line feed (ASCII decimal 10). Many computers respond to either end terminator, while others need the line feed. A few computers, however, may stop accepting data when the carriage return is received, leaving the VG91 hung up and waiting to send its last line feed character. If this happens, put an extra GET or INPUT statement into your control program to let the VG91 send its last character into an unused variable.

Header				Data																		End	
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
S	T	C		3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CR	LF
R	I	L	E	V		M	E	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CR	LF
V	P	A	T		L	C	B	R	1	1	1	1	1	1	1	1	1	_	_	_	_	CR	LF
V	P	A	T		R	A	S	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	CR	LF
A	M	O	D		M	O	N	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CR	LF
A	F		1	K	H	Z	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CR	LF
A	V	E	R		7	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CR	LF

Table 6 - Example of the data format returned by the VG91.

Error Codes

The VG91 will return an error code when it receives an invalid command. The error code can be triggered by an erroneous channel, level or bus command. Table 7 contains a listing and brief description of each error code.

E1 Invalid bus command or bus command used incorrectly.

E2 Invalid parameter used in command. Possible causes are:

1) Invalid channel number: # less than 2, STD TV channel # >69 or cable channel >125;
2) dot size number not specified or >255.
3) Bar interrupt variable something other than 1 or 0
4) RF-IF level not specified or >5.00
5) Pilot % not specified or >100.

E3 Function not allowed in present mode of operation. Possible causes are:

1) Attempting to increment channels with IF signals selected
2) Attempting to set Raster Colors when a non-background raster pattern is selected.
3) Attempting to turn EIA SPLIT FIELD ADDER on without EIA COLOR pattern selected

Table 7 - VG91 bus error codes.

NOTES

APPLICATIONS

INTRODUCTION

The Applications in this section will help you use the VG91 to its fullest capabilities. This section has 4 main parts that cover the major functional areas of television-video equipment: 1) RF Tuner, 2) Video IF, 3) Video, and 4) Audio.

You can use the Applications section two ways: First, it can serve as a reference on how to do a specific test. For example, details on how to test and align a comb filter are in the section entitled "Testing and Aligning Y/C Comb Filters." Use the Table of Contents to find the information or test procedure you want.

You also can use this Applications section as a guide to troubleshooting television/video equipment. The material is arranged in a logical sequence for testing and troubleshooting major functional blocks common to TV-video equipment, beginning at the RF antenna input.

Television-Video Functional Blocks

A basic video system has 2 sections: video and audio. A TV-RF system adds three stages ahead of these stages: Video IF, Tuner, and Audio IF. Figure 41 shows a functional block diagram of a TV-video system. The TV tuner stage converts the RF signal to an IF frequency; the video-IF stage amplifies and filters the IF signal; the video stage processes the luminance and color information; the audio IF recovers the RF audio; and the audio stages amplify the detected sound signal. A TV-video product may contain only a few of these operational sections or all five. Identifying these sections and the common functional blocks within each greatly simplifies testing and troubleshooting of TV-Video products.

For simplification, this application section describes the VG91's tests and procedures using the TV-Video system block diagram. Keep in mind the VG91 may be applied to a video product that contains just one, or all the operational blocks.

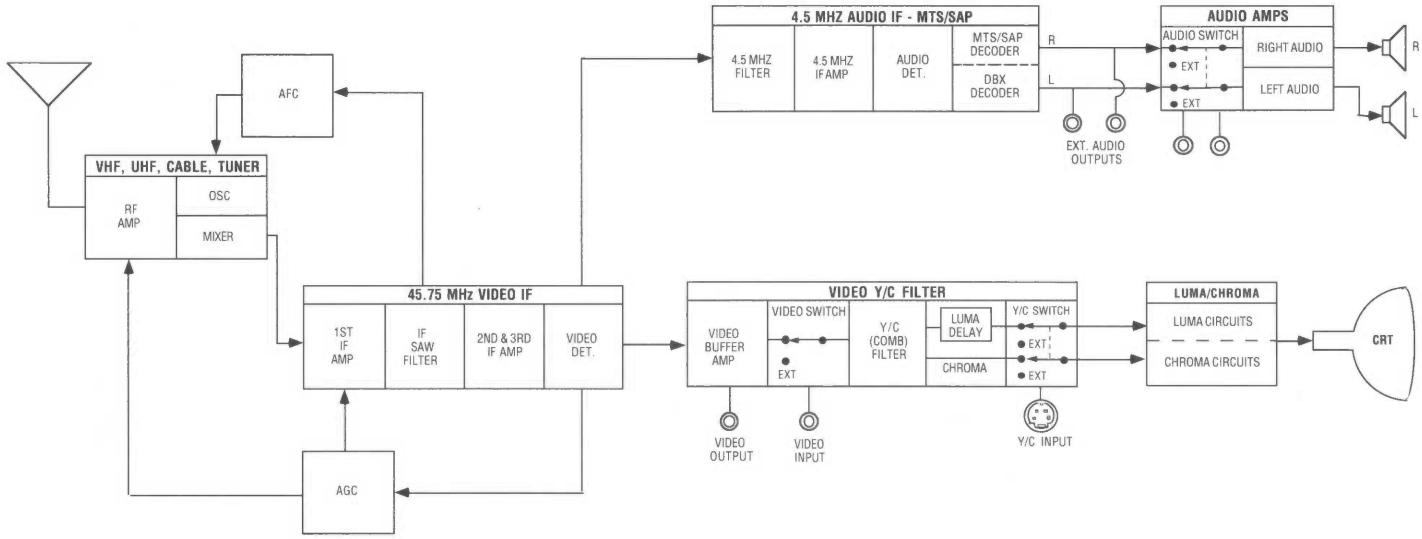


Fig.41 - Typical TV-Video System block diagram

Performance Testing

The first step in troubleshooting any TV-RF or video system is to confirm symptoms or customer complaints by performance testing. Performance testing also should be the final step after you repair the chassis to insure total operation. The VG91 provides modulated reference signals so that you can observe the operation at the outputs using the system's CRT, an external monitor, or an oscilloscope.

To reliably performance test the system you need to apply a known-good signal at a known level. Over-the-air and cable signals vary in signal level, video content, and signal quality. These variations make it extremely difficult to properly evaluate the system's performance. The special patterns, adjustable RF-IF levels, AFT test frequencies, and standard outputs supplied by the VG91 allow you to evaluate the operation of each functional block common to TV-video systems.

The VG91 performance tests fall into two general categories: 1) Testing receiver tuner and IF circuits and 2) testing video and audio processing circuits.

The connections between the VG91 and the video system will differ depending on which category you are testing. For example, to test the receiver portion (tuner/IFs) of a VCR or TV you would apply RF signals to the tuner input. To test the audio and video processing circuits of a video monitor or VCR you would apply a signal to the VIDEO and AUDIO LINE IN jacks of the system.

Table 8 and 9 outline the performance tests. Figures 42 and 43 show the testing setups. The remainder of this Application Section explains these performance tests in more detail.

TUNER/IF PERFORMANCE TESTS

TEST	INSTRUCTIONS	EXPECTED RESULTS	CIRCUITS TESTED
Standard TV Tuner Test	Input Each VHF/UHF Channel at 1000 μV	Good Video Output On Each Channel	Tuner, Tuner Control
Cable Tuner Test	Input Each Cable Channel At 1000μV	Good Video Output On Each Channel	Tuner (Cable Channel Search Control)
RF-IF Sensitivity	Set RF Range to "MED". Reduce Level from 5-2.	Video Become Noisy, Sync & Color Locked	RF/IF Gain, Sync & Color
AGC	Set Range to "HI". Increase Level to 5.	Little or No Change To VIdeo Level	AGC Circuits
AFT	Set Level to 1000μV, Select EIA Color, Perform AFT Tests	AFT Restores Proper Video To + or – Shift	AFT Circuits
IF Video Frequency Response	Select Multiburst Bar Sweep	Stripes To 3.0 Bar, Stripes Fade In 3.5 - 4.0 Bars. Roll-Off In 3.0-4.5 MHz Bars.	IF Alignment
IF Color Bandpass Response	Select Chroma Bar Sweep	Stripes Fade in 4.0 Bar. Roll-Off In 3.5, & 4.0 Bars	IF Alignment
Video Detector	Select 10 Bar Staircase	10 Linear Steps, No Compression	Video Detector Alignment
Audio	Select 300Hz Audio, Select Mono or L&R Stereo Mode	Good Audio Output On Both Channels, Stereo "ON" (MTS Receiver Only)	Audio IF, Det., MTS/Sap Decoder

Table 8 - Tuner/IF Performance Tests

To perform tuner/IF performance tests:

1. Connect the RF-IF TEST CABLE from the RF-IF OUTPUT to the receivers RF or antenna input.

2. Select the VG91 as instructed to match the TUNER/IF Performance test to be performed.

3. Select the VG91 channel using the keypad and digital readout.

4. Select the receiver as needed to match the test to be performed.

5. Monitor the outputs.
   a. Connect a video monitor or scope to the video output. Compare to expected results in chart.
   b. Connect a speaker or scope to the audio output. Compare to expected results in chart.

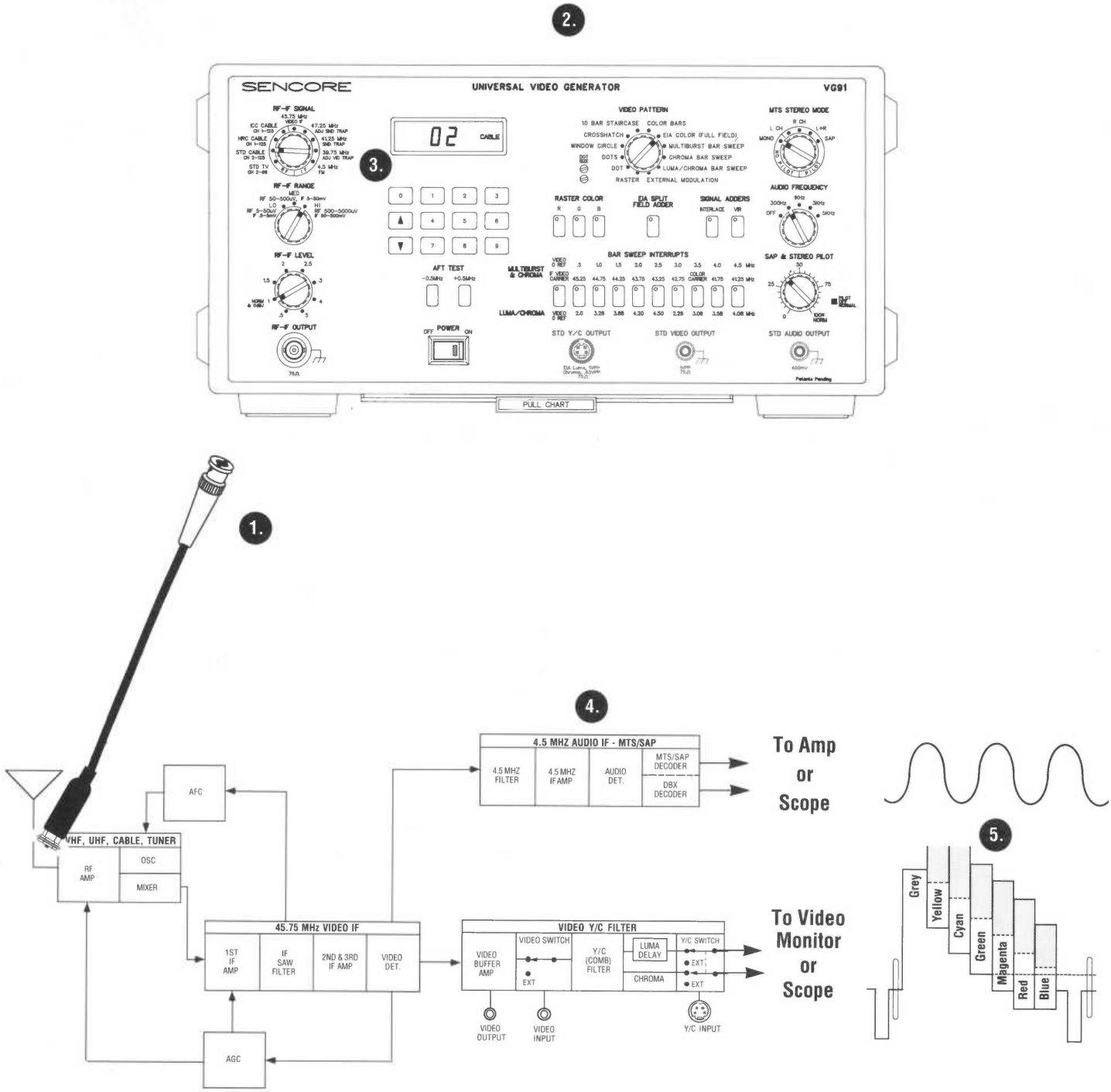


Fig.42 - Set-up for Tuner IF performance tests.

AUDIO/VIDEO PERFORMANCE TESTS			
TEST	INSTRUCTIONS	EXPECTED RESULTS	CIRCUITS TESTED
B&W Tracking Grey Scale	Input 10 Bar Staircase	Black To White Bars, Linear Steps, No Color	Video Amps, CRT Bias & Drives
Luminance Frequency Response	Input Multiburst Bar Sweep To Video Input	Stripes To 3.5 or 4.0 Bars, Roll-Off Above 3.0 MHz	Luma Circuit Response
Chroma Frequency Response	Input Chroma Bar Sweep to Video Input	Stripes To 3.0 & 4.0 Bars, Bars About Same Amplitude	Chroma Circuit Response
S-Video Input, Frequency Response	Input Luma/Chroma Bar Sweep to Y/C Input	Stripes To 3.8, 4.2 & 4.5 Luma Bars, Color Stripes In 2.28, 3.08, & 4.08	Luma & Chroma Processing Circuits, CRT
Color Demodulator	Input Color Bars	Show Rainbow Of Colors From Orange To Green	Color Amps & Demodulators
Color Tint	Input Chroma Bar Sweep Rotate Tint Control	3.58 Bar Changes Green To Blue, Set To Cyan	Color Osc., Tint Control
Color Killer	Switch to B&W Pattern & Back To Color Bars	No Color In B&W Pattern	Burst Gating, Color Killer
Picture Centering & Linearity	Input Window Circle Pattern	Centered Cross, Round Circle, Box Equal Distance At Picture Edges	Yoke, Deflection, Pin-cushion, Centering, etc.
Purity	Input Raster Colors, Select Color	Uniform Color	Purity
Convergence	Input Dot(s), Crosshatch	White Dot(s) or Lines	Color Convergence
Audio	Input Audio Tones to STD Audio Input	Good Audio Output	Audio Amps

Table 9 - Audio/Video Performance Tests.

To perform audio and video circuit performance tests:

1. Connect cable from the VG91's STD VIDEO, Y/C OUTPUT or AUDIO OUTPUT to inputs using supplied test cables.

2. Set the TV/video equipment to select the Standard, Video, Y/C, or Audio line inputs.

3. Set the VG91 VIDEO PATTERN switch and/or AUDIO FREQUENCY switch to match the performance test.

4. Monitor the outputs.
   a. Connect a video monitor or scope to the video output. Compare to expected results in chart.
   b. Connect a speaker or scope to the audio output. Compare to expected results in chart.

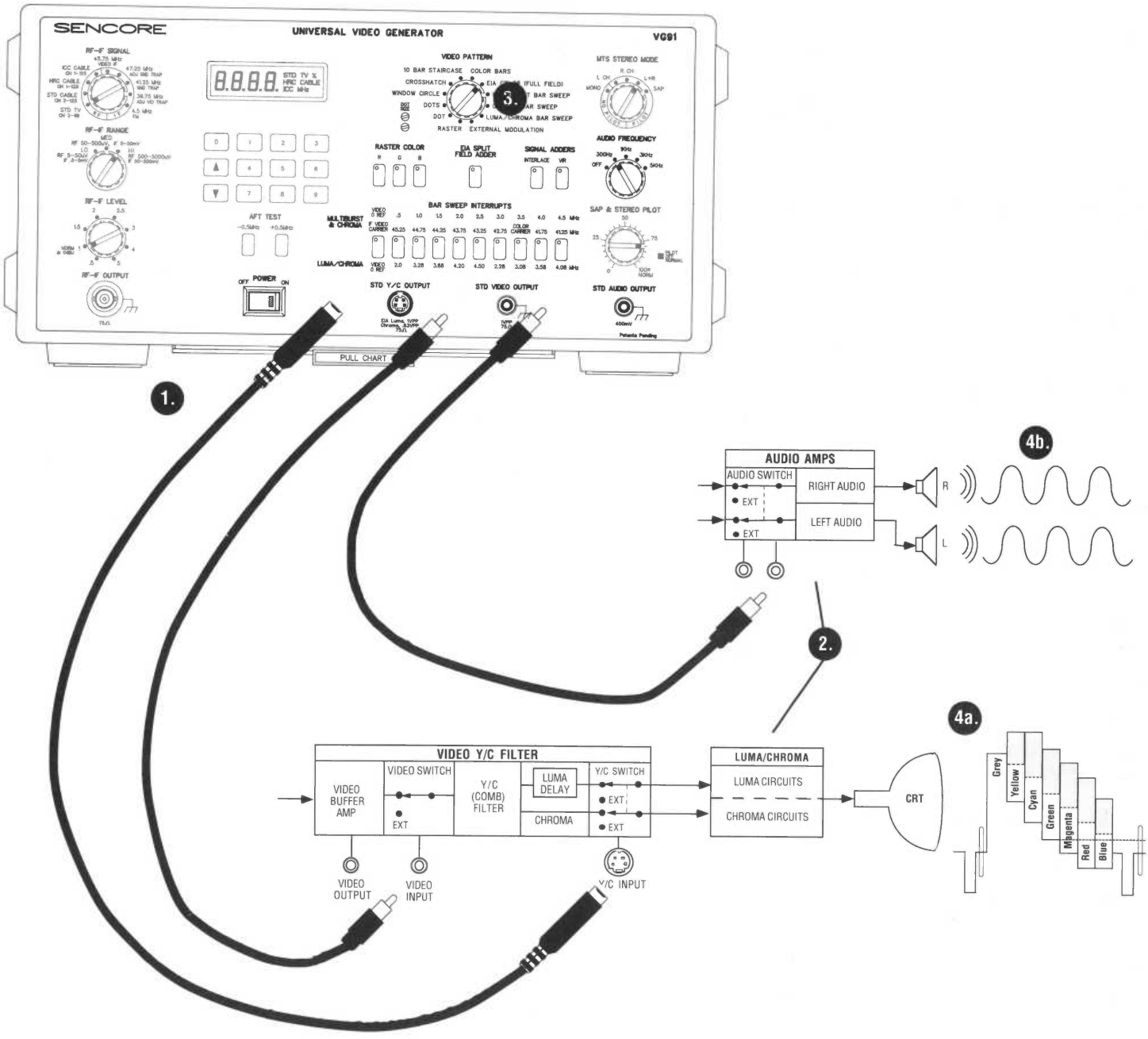


Fig. 43 - Audio/Video Performance Tests.

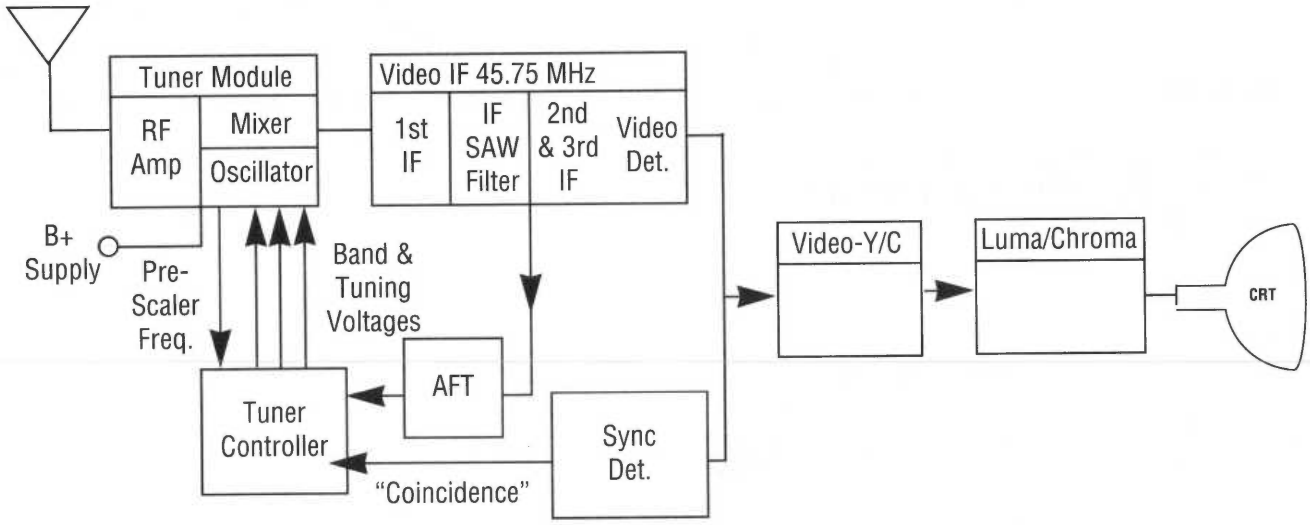


Fig. 44: - Block diagram of a typical "all channel" digital tuning system.

There are two basic types of tuners used in TV-RF systems - cable ready and non-cable ready. When testing non-cable ready tuners (tuners that only receive off-air VHF/UHF channels) you only need to use the STD TV mode on the VG91. Most new digital tuners, however, are "all channel cable ready" and can select all of the off-air or cable signals. This is done with a user switch or programmable setting commonly called "Normal TV" or "Cable". These tuners require more extensive testing to ensure correct operation.

Cable TV systems may shift some or all the channel carriers as much as ±2 MHz from the standard broadcast frequencies. Conventional tuners require the customer to adjust the fine tuning to match the offset carrier. Digital tuners use extra control circuits to do this automatically. As a result, digital tuners operate differently in the "cable" mode than in the "normal TV" mode.

In the "normal TV" mode, digital tuners go to the center frequency of the TV channel. The AFT voltage fine tunes the tuner to center the IF signal. In the "cable" mode, digital tuners auto-search for a TV-RF carrier up to ±2 MHz from the standard center frequency of the channel. When a TV signal is found the tuner locks to the channel and begins normal AFT action. If no signal is found after several searches, the tuner returns to the center channel frequency.

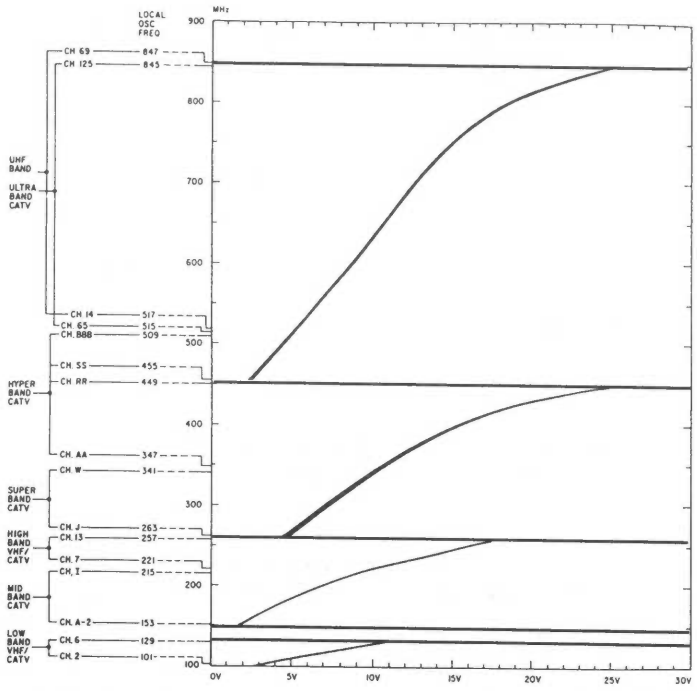
The cable channel search routines initiated by digital tuners vary between manufacturers and are activated differently. Some implement a channel search only after a channel is entered on the keyboard, while others implement a search with a channel selection or anytime AFT indicates a loss of signal.

Use the "STD TV" position of the VG91's RF-IF SIGNAL switch to test tuners for proper off-air VHF/UHF reception. Use the "CABLE", "HRC CABLE", or "ICC CABLE" positions to duplicate the standard, HRC or ICC cable system when testing cable-ready tuners. For example, if the customer subscribes to an HRC cable system, set the VG91 to "HRC CABLE". Select the channels that the customer is complaining of, or do a quick performance test of the channels in each tuning band.

You do not need to test every channel on a digital tuner to be sure that each channel works. A digital tuner has several channel bands, as illustrated in Figure 45. The most likely problem channels are at the upper and lower edge of each tuning band. These channels require the tuner to operate near its extreme limits and are the most difficult for the automatic circuits to capture. Be sure to check these channels when performance testing the tuner. It is also possible for a digital tuner to have a "stuck bit." This occurs when one data line does not work. The result is that the tuner will skip every 2nd 4th, 8th or 16th channel. Besides checking the lowest and

highest channel in each band, also check the 2nd, 4th, 8th, and 16th channel on one of the bands.

Note: Confirm that the tuner has tuned a channel by viewing the picture at the VIDEO OUT jack or CRT. It is possible for the channel indicator to show the selected channel when the tuner has not actually tuned the channel.



Courtesy of Philips Consumer Electronics

Fig. 45 - Digital tuners uses several tuning bands. Confirm the operation of the lowest and highest channel in each band.

To Test VHF/UHF or Cable Channel Tuning:

1. Connect the RF cable from the RF-IF OUTPUT of the VG91 to the RF tuner input of the receiver. Use the matching balun if the receiver does not have a 75Ω "F" connector.

2. Set the VG91 as follows:
   a. RF-IF SIGNAL to "STD TV" or "CABLE".
   b. RF-IF RANGE to "Hi".
   c. RF-IF LEVEL to "1".
   d. VIDEO PATTERN to "EIA Color Bars".
   e. MTS STEREO MODE to "Mono".
   f. AUDIO FREQUENCY to "off".

3. Select the desired channel on the VG91.

Important: Set the channel on the VG91 before selecting the channel on the receiver. Many digital tuners return to the center channel frequency when no signal is detected and may improperly tune if the signal is not present first.

4. Set Receiver as follows:
   a. Select the "Normal TV" (off-air) or "Cable" tuning mode to match the VG91.
   b. Select the tuner input.
   c. Select the channel of the receiver to match the VG91.

5. Observe the video and audio output on a monitor or scope.

6. Set the VG91 to another channel, or increment the channels and set the receiver to correspond. Repeat step 5.

The receiver should produce a good picture and good audio on the monitor or video output on each channel tested. Poor reception indicates a tuning problem. Use the following Performance Tests to help isolate the problem further.

Testing Receiver Sensitivity And AGC

TV RF receivers are designed to provide a viewable picture with signal strengths that vary from less than 500 uV to over 5,000 uV. Most of the background noise (snow) seen on weak signal is generated in the tuner mixer stage. To override this noise and obtain a good signal-to-noise ratio, the mixer must be driven with a strong signal. The needed amplification is accomplished by the RF amplifier. Problems in the antenna input, tuned circuits or RF amplifier may reduce the signal level to the mixer and cause a snowy picture. On the opposite extreme, excessive signal creates overload interference and dark contrast. The output of the video detector must remain constant despite the strength of the incoming signal.

An automatic gain control (AGC) circuit is used to maintain a constant output from the video detector as the input RF signal varies. The gain of the RF amp and 1st IF amp is reduced on strong signals to prevent overload. These stages are allowed to operate at maximum gain for weak signals. AGC problems can cause snowy reception or overload problems.

Proper receiver sensitivity and AGC circuit operation can be tested using the VG91's accurate RF signal levels.

To test sensitivity and AGC:

1. Set the VG91 and receiver as explained in steps 1-3 in the procedure for "Testing VHF/UHF or Cable Channel Tuning" on page 42.

2. Decrease the RF-IF LEVEL to 500 μV.

3. Observe the monitor or VIDEO OUT jack for snow.

4. Increase RF-IF LEVEL to 5,000 μV.

5. Observe the monitor or VIDEO OUT jack for picture or signal quality.

A working receiver should produce an acceptable video picture at 1000 μV input level (normal). Most receivers begin to show snow when the level drops to about 500 μV. However, the receiver should maintain sync and color. The receiver's gain should reduce as you increase the level to 5,000 μV, so you should see little change in the video level or monitored video. You can use a DVM to monitor the AGC voltage. Compare the measured reading to the amount listed in the service literature and set the AGC control if the chassis has an adjustment.

Testing AFT Operation

The incoming RF signal mixes with the local oscillator signal inside the tuner to produce a 45.75 MHz IF carrier. If the local oscillator frequency drifts the IF carrier frequency will be incorrect and the signal will not pass through the IF stages properly. TV-RF receivers use an automatic fine tuning (AFT) system to maintain the correct IF carrier frequency. The AFT circuit senses a frequency change in the IF carrier and applies a correction voltage to the local oscillator.

The role of the AFT circuits is slightly different between mechanical and digital tuners. In mechanical tuners fine tuning is done manually. The receiver has a switch to defeat the AFT circuits while you adjust the fine tuning. After the tuner is manually fine tuned, you turn the AFT back on.

The AFT circuits in digital tuners are always active and cannot be switched off. The AFT works with the digital tuner to center the 45.75 MHz IF carrier in the IF passband. The AFT circuits must be properly aligned and working for a digital tuner to tune correctly.

All receivers can adjust the local oscillator to compensate for a shift of ±500 kHz. Test the AFT circuits by shifting the incoming TV channel signal and observing if the AFT circuits restore proper operation. The VG91's AFT test makes this easy to do.

To test Tuner AFT Operation:

1. Set the VG91 and receiver as explained in steps 1-3 in the procedure for "Testing VHF/UHF or Cable Channel Tuning" on page 42.

Note: Before testing AFT operation on receivers with manual tuning, turn the AFT switch off and manually tune the receiver. Then turn the AFT switch on.

2. Confirm proper receiver reception, then push and hold the AFT TEST "-0.5 MHz" button.

3. Confirm proper output on the monitor or VIDEO OUT jack. Release the AFT TEST "-0.5 MHz" button.

4. Repeat the test pushing and holding the AFT TEST "+0.5 MHz" button.

The video will momentarily degrade when you first press the AFT TEST button until AFT restores proper tuning. If the AFT does not return the video to proper operation when either the "+ 500 kHz" or "- 500 kHz" button is pressed the AFT is not operating correctly. If the video returns to normal in one shift direction but not the other the AFT circuits are not aligned properly.

AFT Troubleshooting And Alignment

Problems in the AFT circuits may cause improper tuning, or AFT lock-in range problems. If the AFT detector is not tuned to the 45.75 MHz carrier the AFT will pull the fine tuning off frequency instead of on to the correct frequency. If the AFT is not properly centered the AFT lock-in range may be inadequate.

Troubleshoot and align an AFT circuits with the VG91's 45.75 MHz Video-IF signal connected to the input of the IF stages. Use a DVM to measure the AFT voltage returned to the tuner. The VG91's accurate 45.75 MHz IF carrier centers the tuner AFT voltage within the AFT correction voltage range while the AFT TEST shifts the VG91's IF carrier to simulate a drift in the local oscillator. The AFT circuit should respond to the AFT TEST shifts by a change in the AFT voltage returned to the tuner.

To troubleshoot and align AFT:

1. Connect the RF-IF output cable to the VG91 RF-IF OUTPUT jack.

2. Connect the RF-IF output cable to one of the following points in the receiver chassis: 1st IF input; SAW input; or IF IC input. Use one of the supplied adaptor connectors or the IF TROUBLESHOOTING BALUN to make the connection.

3. Set the VG91 as follows:
   a. VIDEO PATTERN to "Raster
   b. Turn off all the "Raster Colors" for a black raster.
   c. RF-IF SIGNAL to "45.75 MHz Video IF".
   d. RF-IF RANGE & LEVEL to produce noise free video.

4. Connect a DVM to the AFT test point in the tuner. (If the chassis uses two AFT leads connect the DVM across both connections)

5. If the receiver uses manual tuning (AFT can be turned on and off):
   a. Turn the AFT switch off and back on and note any difference in voltage.
   b. Align the AFT detector coil so that the AFT voltage is the same with the switch on & off.

6. If the receiver does not have an AFT switch:
   a. Push and hold the AFT TEST " -0.5 MHz" button.
   b. Record the change in AFT voltage.
   c. Release the AFT TEST button.
   d. Push and hold the AFT TEST "+0.5 MHz" button.
   e. Record the change in AFT voltage.
   f. Release the AFT TEST button.
   g. Align the AFT detector coil to set AFT voltage in the middle of the voltages measured in step b and e.

7. Repeat step 5 or 6 as necessary to center the AFT voltage and obtain equal positive and negative correction voltages.

Note: If the AFT system uses more than one adjustment, align the detector coil to center the AFT voltage range at 45.75 MHz. Then adjust the other coils for equal positive and negative voltage changes when the AFT TEST buttons are pushed.

The AFT voltage should change approximately equal amounts but opposite polarity to the "+" and "-" carrier shift. Unequal voltage changes to the AFT TEST shifts indicates improper AFT centering and the need for alignment. No change in the AFT voltage indicates an AFT problem.

If the AFT Detector is severely misaligned, inject the VG91's 45.75 MHz Video IF carrier and monitor the DVM while adjusting the AFT detector coil. Determine the coil setting that produces the fastest voltage change between minimum and maximum. Then adjust the coil to center the output within this maximum and minimum voltage change.

As a final test of complete AFT operation, apply an RF signal to the antenna and use the AFT TEST to shift the RF carrier (see the tuner AFT Operation Testing on page 43). Again monitor the AFT voltage with a DVM. The AFT voltages should be approximately the same as those observed when the IF 45.75 MHz was used. A large difference indicates a problem with the tuner.

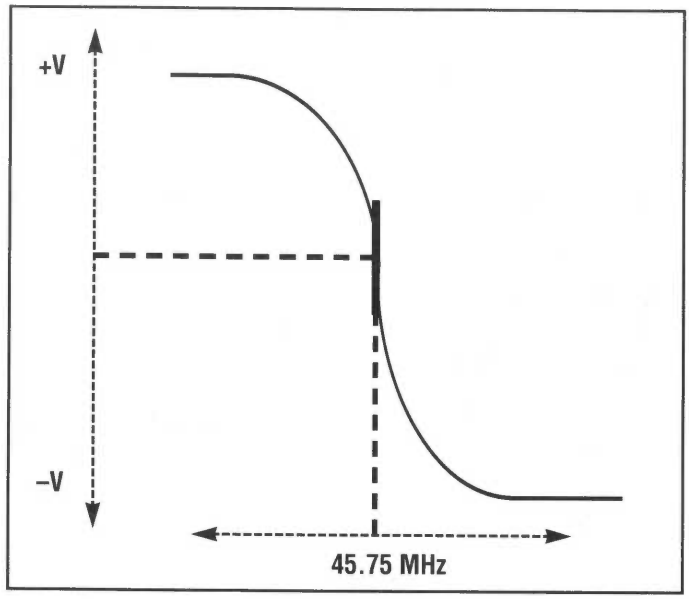


Fig. 46 - The AFT voltage should be centered at 45.75 MHz and change equally to minimum and maximum levels with the VG91 AFT TESTS.

VIDEO-IF STAGES

The video-IF stages amplify the signal selected by the tuner and reject any undesired signals, such as the carriers from adjacent channels, which could cause interference. The video detector demodulates the video signal from the IF carrier. Because it is now part of most IF processing ICs, the detector may be considered the last functional block of the Video-IF.

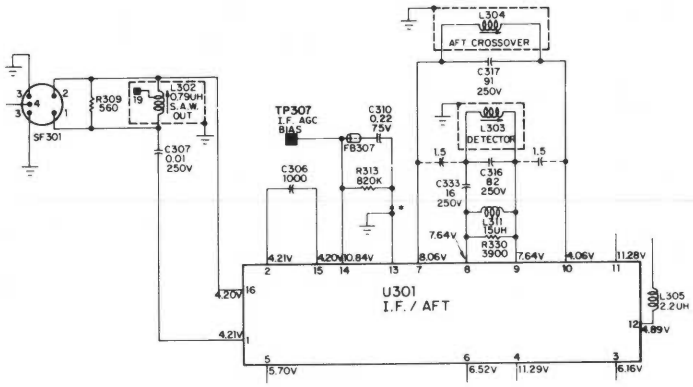


Fig. 47 - The video detector is part of the IF processing IC in many chassis.

Because the modulated IF carrier requires a wide passband several stages of amplification are used. Typical receivers have 3 IF amplifier stages with each having a gain of 15-20. A common IF configuration is a discrete 1st IF transistor stage followed by a SAW filter and video/IF IC. The VG91 provides 3 RF-IF ranges with 20 dB steps to correspond to the levels found in typical receivers.

The bandpass response of the IF is important to picture detail - if the bandpass is too narrow the high video frequencies will be lost and picture detail reduced; if the bandpass is too wide adjacent channel carriers will cause interference.

Troubleshooting Video-IF Stages

Problems in tuners and IF stages often produce similar symptoms. This section will show your how to isolate problems in the video-IF stages using the VG91.

The first step in separating a tuner problem from an IF problem is to substitute a known good 45.75 MHz Video-IF signal into the 1st video-IF amplifier. If the receiver has a tuner/IF link cable unplug it and use one of the supplied VG91 adapters to apply the VG91 signal into the IF. If the tuner module is mounted on the main board use the IF TROUBLESHOOTING BALUN to connect to the IF circuit points.

In some receivers the 1st IF amplifier is located inside the tuner module. Substitute the 45.75 MHz video-IF into the 2nd IF amplifier, SAW filter, or into the balanced input of the IC on these receivers . You will need to inject a higher signal level into these stages. The typical IF input level to a SAW filter preceded by an IF amplifier is 10-30 mV (Med 1-3).

Use the following setup whenever you need to inject a signal into the IF stages for troubleshooting or performance testing.

Basic setup for injecting into the 45.75 MHz Video-IF:

1. Connect the RF-IF output cable to the VG91 RF-IF OUTPUT jack.

2. Connect the RF-IF output cable to one of the following points in the receiver chassis: 1st IF input; SAW input; or IF IC input. Use one of the supplied adaptor connectors or the IF TROUBLESHOOTING BALUN to make the connection.

3. Monitor the output of the TV RF receiver using one of the following methods: a) the CRT in a television receiver; b) a monitor connected to the VIDEO OUT jack; or c) an oscilloscope connected to the VIDEO OUT jack. Monitor the audio output if you troubleshooting an audio problem.

4. Set the VG91 as follows:
   a. VIDEO PATTERN to desired "Bar Sweep" pattern.
   b. RF-IF SIGNAL to "45.75 MHz Video-IF".
   c. RF-IF RANGE & LEVEL:
      1st IF input = 1-3 mV.
      SAW input = 10-30 mV.
      IF inputs = 20-50 mV.
   d. MTS MODE to "mono" or "stereo" as required.
   e. AUDIO FREQUENCY as required. (Leave "off" unless you are testing or troubleshooting the audio stages).

5. Increase RF-IF LEVEL and check monitor or audio output for proper operation.

6. Inject the 45.75 MHz signal to a prior or latter stage to isolate the defective stage.

Note: When substituting into the balanced IC input with the IF TROUBLESHOOTING BALUN you need to connect a ground between the receiver chassis and the VG91 chassis ground. Use the supplied ground clip for the IF TROUBLESHOOTING BALUN and ground the RF side of the balun to the IF circuit ground.

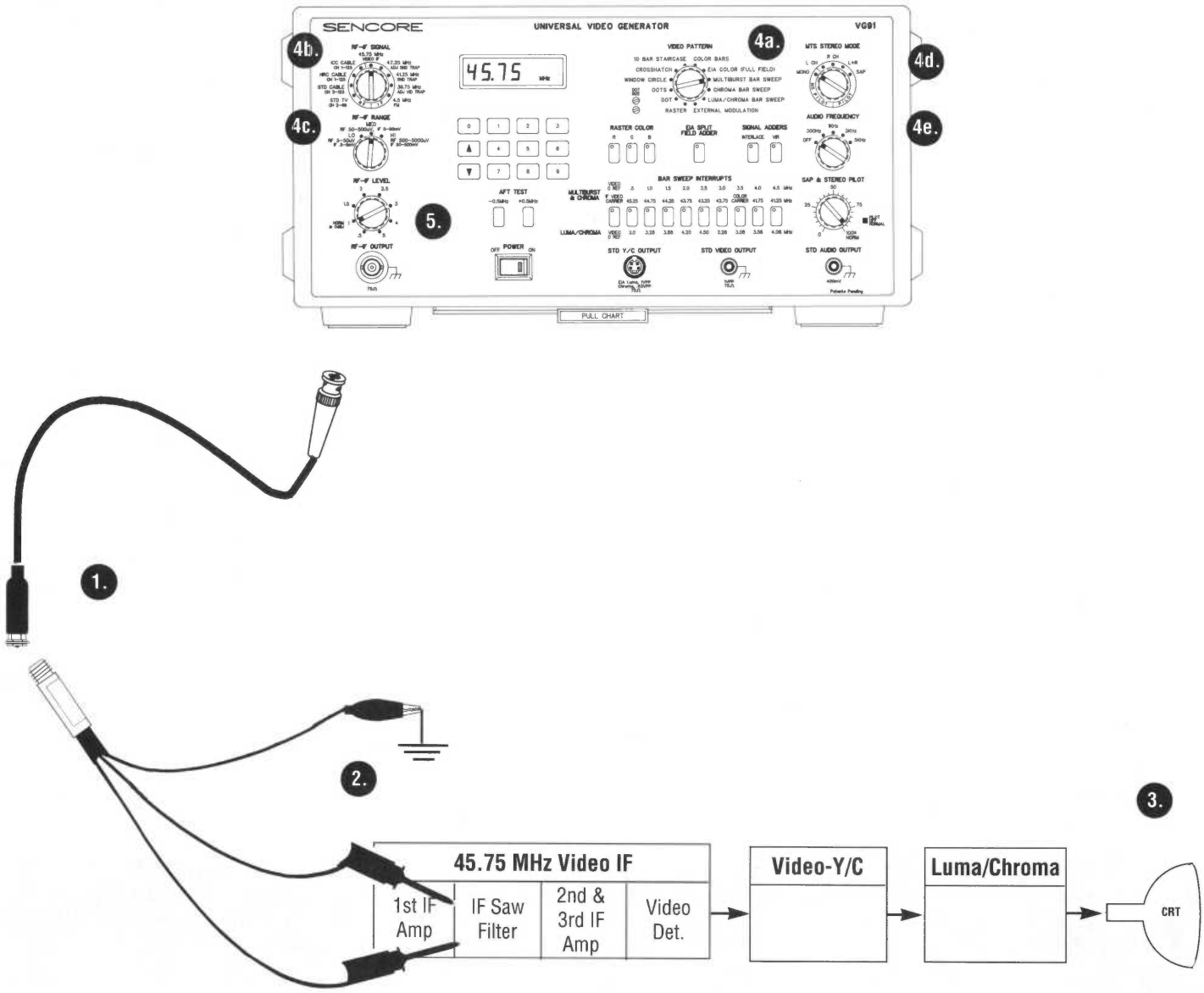


Fig. 48 - Basic set-up for injecting into the IF stages.

CAUTION

You must plug the receiver into an isolation transformer to prevent damage to the receiver when you make this or other ground connections.

Testing IF Response

The IF bandpass requirements differ between TV-RF receivers. A large screen television typically has a bandpass of 3.5-4.0 MHz to display good picture detail. Small screen televisions usually have about 3 MHz of bandwidth, while a B&W receiver has only a 2-2.5 MHz bandwidth. (The narrow bandwidth in a B&W receiver is necessary to prevent the color signals from interfering with the luminance signals.)

IF bandwidth is determined by the alignment of LC tuned circuits or by the fixed response of a SAW filter. LC tuned circuits easily drift or change alignment due to thermal or mechanical stresses. SAW filters may also become defective and drift.

The VG91's Multiburst Bar Sweep video pattern quickly tests the complete response of video-IF stages. This pattern provides various video frequencies that allow you to test the IF response by visually observing the output of the video detector. Appendix B shows how the IF response curve compares to the VG91's Multiburst Bar Sweep pattern.

Use the following procedure to test the bandpass of the entire tuner and IF section.

To test the video response of the tuner & IF stages:

1. Set the VG91 as follows:
   a. RF-IF SIGNAL to "TV".
   b. RF-IF RANGE to "Hi"..
   c. RF-IF LEVEL to "1".
   d. VIDEO PATTERN to "Multiburst Bar Sweep".

2. Connect the RF cable from the VG91's RF-IF OUTPUT jack to the receiver's RF input.

3. Select channel 2 on the VG91.

4. Tune the receiver to channel 2.

5. Compare the picture on the monitor, or waveform at the VIDEO OUT jack to the displays in figure 49. (Use the BAR SWEEP INTERRUPTS buttons to help identify the frequencies).

Note: This test checks the total response of the tuner, video-IF, and video detector stages. The tuner typically has a bandwidth of 6 MHz for each channel and should not alter the video response. Each RF channel should have a similar frequency roll-off. However, if you suspect the tuner, inject the VG91's 45.75 MHz Video-IF signal directly into the IF as explained in the section "Basic setup for injecting into the 45.75 MHz Video-IF" on page 45 and repeat the test. If the response noticeably improves when you inject into the IF, suspect a tuner problem. Troubleshoot this problem by confirming proper AFT operation and alignment.

You can determine if the receiver is passing a video frequency using either a monitor connected to the receiver's VIDEO OUT jack (the CRT in a television) or an oscilloscope connected to the VIDEO OUT jack or video detector output. Each frequency bar of the Multiburst Bar Sweep pattern produces a series of B&W vertical stripes. As the video frequency increases, the stripes become closer together. The last band of visible stripes shows the highest video frequency passed by the receiver.

Note: If you are using an external monitor connected to the VIDEO OUT jack, be sure that monitor has a wider bandwidth than the receiver that you are testing.

Besides looking for visible stripes, decrease the brightness and contrast controls on the monitor to see how the gain at one frequency compares to the others. A frequency bar that is reduced in level will turn dark before the others. In a properly aligned chassis the bars will disappear from right to left.

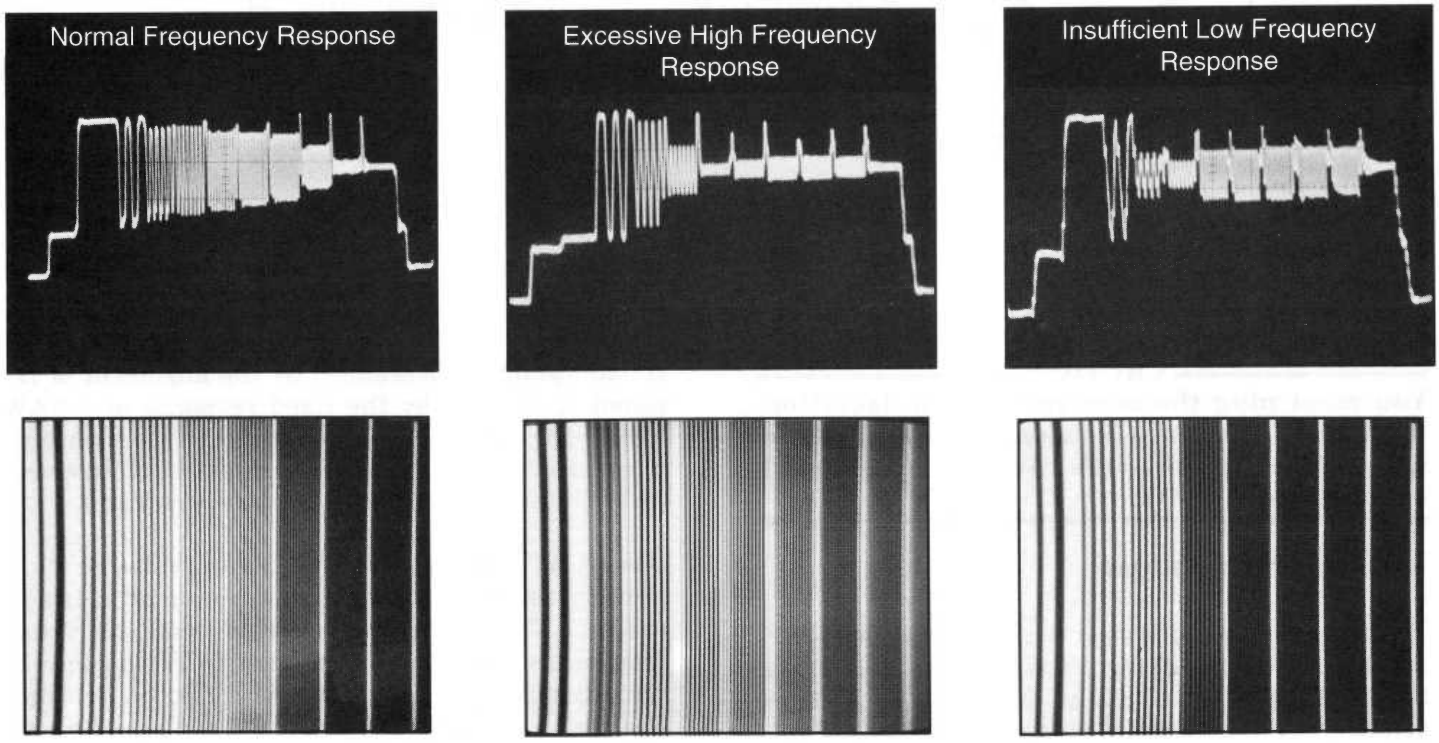


Fig. 49 - (Left) A normal frequency response. Excessive high frequency response (center) results in ringing and overshoot. Insufficient low frequency response (right) causes the low frequency bars to roundoff and the high frequency bars to rolloff too quickly.

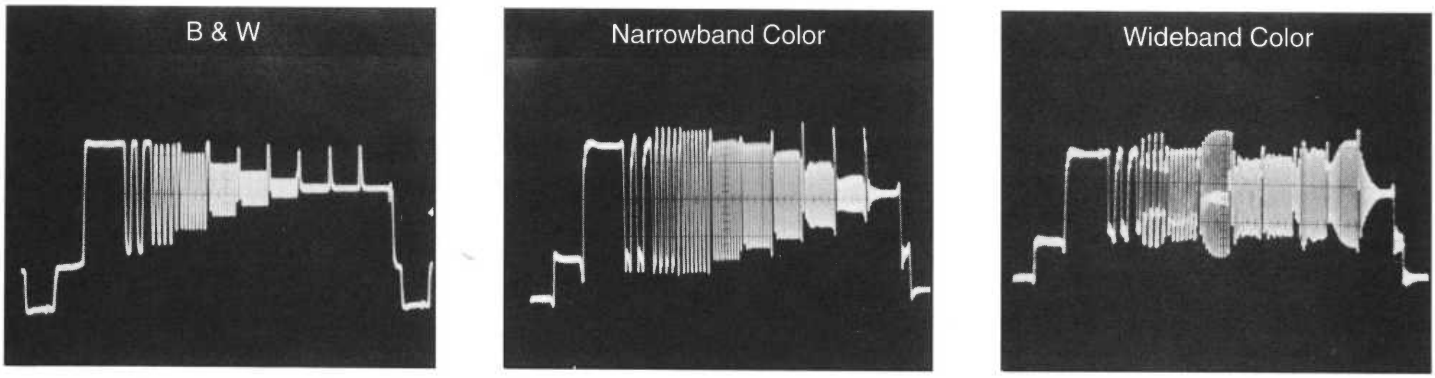


Fig. 50 - Typical Multiburst Bar Sweep pattern as seen at the video detector output of a 1) B&W, 2) narrow-band color; 3) wide-band color (IDTV) television receiver.

Figure 50 shows the response of several television receivers as they would appear on an oscilloscope. The sync should not be compressed and none of the bars should have overshoots or ringing. The bars between .5 and 2.0 MHz should be equal amplitude. In a narrowband color receiver, the bars above 2.5 MHz should have a smooth rolloff. The 3.5 MHz bar should be approximately 50% of the amplitude of the first two bars. A wideband color receiver has a wider IF response resulting in a more uniform gain

Testing Chroma Response

The transmitted color signals consist of lower I sideband signals extending 1.3 MHz below the 3.58 MHz color carrier, and upper Q sidebands extending .5 MHz above the color carrier. The wideband I signal contains information that increases color detail on colors such as orange and cyan. Receivers that take advantage of the full I signal are often called "wideband" color receivers. Many receivers however, are "narrowband" and use only .5 MHz of the I sideband signal. This bandwidth provides reasonable color detail and is easier to demodulate.

Figure 51 shows the difference in the IF response between a wideband and narrow band color receiver. The broadband receiver extends the response to increase the gain of the chroma frequencies. If a receiver shows weak color use the VG91 to confirm that the tuner and IF stages are properly passing the color sideband information.

To test the chroma bandpass of the tuner/IF circuits:

1. Set the VG91 as follows:
   a. RF-IF SIGNAL to "TV".
   b. RF-IF RANGE to "Hi"..
   c. RF-IF LEVEL to "1".
   d. VIDEO PATTERN to "Luma/Chroma Bar Sweep".

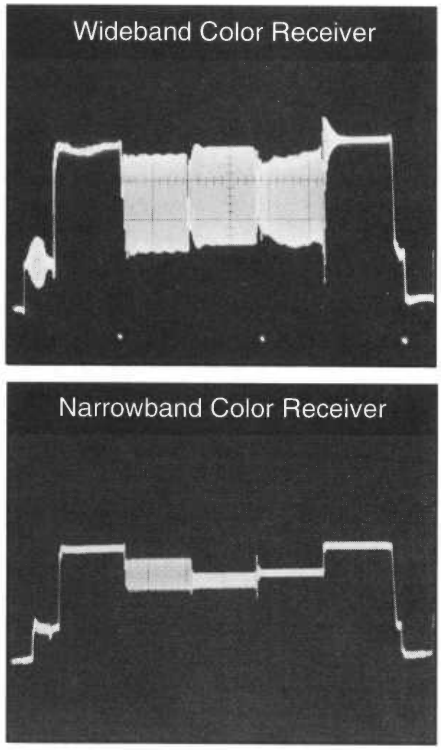


Fig. 51 - A wideband color receiver (top) has a wider IF response that allows more uniform gain in the chroma IF passband.

2. Connect the RF cable from the VG91's RF-IF OUTPUT jack to the chassis RF input.
3. Select channel 2 on the VG91.
4. Tune the receiver to channel 2.
5. Compare the waveform at the VIDEO OUT jack to the displays in Figure 51. (Use the BAR SWEEP INTERRUPTS buttons to help identify the frequencies).

A narrow band receiver should show a smooth rolloff in the bars between 3.08 MHz and 4.08 MHz. The amplitude of the 3.58 MHz bar should be approximately 50% of the 3.08 MHz bar. In a wideband receiver the amplitude of the 3.08 to 3.58 bars should be similar, and the 4.08 MHz bar should be reduced.

Testing And Aligning IF Traps

IF traps reject frequencies that may cause interference in the picture or sound and help shape the IF response. Three standard trap frequencies may be used in a TV-RF receiver: 39.75 MHz (upper adjacent channel picture); 47.25 MHz (lower adjacent channel sound) and 41.25 MHz (on channel sound). Rejecting the adjacent channel carriers is especially important for cable reception where adjacent channel carriers are located directly above and below the selected channel. The 41.25 MHz trap reduces the tuned channel's sound IF carrier to prevent buzz in the sound and 920 kHz beats in the picture on color receivers.

The SAW filters used in modern IF circuits have eliminated most of the LC traps. Many SAW filter circuits, however, still contain at least one adjustable trap. Proper adjustment of IF traps is critical - if the 39.75 MHz trap is set too high in frequency it will reduce the audio or chroma levels; if the 47.25 MHz trap is set too low it will reduce the IF response and reduce picture detail. Check the adjacent channel rejection if the performance of the SAW filter is in doubt.

The VG91 provides three special signals to dynamically check and align traps. In each signal a fixed-level 45.75 MHz video-IF carrier is modulated with the video signal selected by the VIDEO PATTERN switch. The "RF-IF SIGNAL" and "RF-IF LEVEL" controls adjust the strength of an interference carrier that is added to the standard IF signal. The video signal holds the AGC to a constant level and the interference duplicates the signal that the traps are designed to reject.

To test or align an IF trap:

1. Connect the VG91 to the receiver as explained in the "Basic Setup For Injecting Into The 45.75 MHz Video-IF" on page 45.
2. Set the VG91 as follows:
   a. VIDEO PATTERN to "Multiburst Bar Sweep". Turn off the "3", "3.5","4", & "4.5" bars.
   b. RF-IF SIGNAL to the desired trap frequency.
   c. Set the RF-IF RANGE and RF-IF LEVEL controls to "0".
3. Adjust the RF-IF RANGE and RF-IF LEVEL controls until interference is visible on the output. Use the smallest level of interfering signal that provides noticeable interference.
4. Adjust the trap coil(s) to minimize the interference in the output. If you are using an oscilloscope to monitor the output, adjust the trap for the least thickness of the vertical sync pulse.
5. If the trap adjustment eliminates the interference increase the signal level slightly to confirm a proper null.
6. Repeat steps 3 and 4 for the remaining traps.

Note: Traps used with SAW filters are less responsive than conventional IFs because of the added attenuation of the SAW filter to the unwanted signal. Watch the results of the trap setting signal very closely when adjusting a trap in a SAW system.

Testing And Aligning The Synchronous Detector

Most of today's TV-RF receivers use a synchronous video detector. Synchronous detectors offer many advantages over the conventional diode detector. Several major advantages are: 1) it is less prone to pickup of unwanted signals; 2) it generates very few beat products; 3) it is linear and gives good contrast range; 4) it produces no output when a carrier is not present, resulting in a black raster. But, the synchronous detector must be properly aligned to fully use these advantages. If it is misaligned it can severely degrade the video.

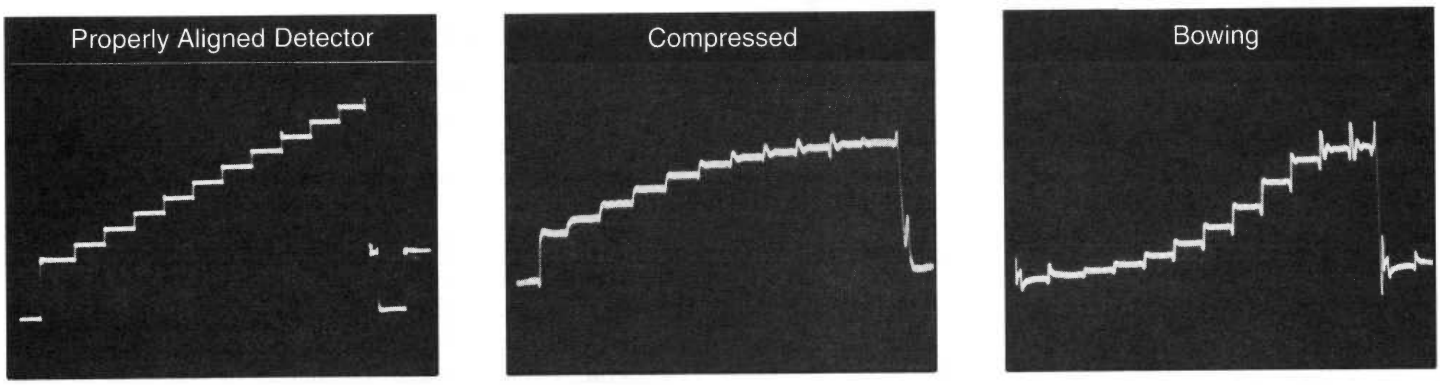


Fig. 52 - Adjust the synchronous video detector for best linear steps. Avoid compression or bowing that alters contrast and brightness ranges.

The synchronous detector requires an IF carrier for operation and therefore cannot be aligned or tested with a sweep and marker generator. The VG91 provides an IF carrier that can modulated with a linear 10 bar staircase pattern to quickly and dynamically test and align a synchronous video detector. To align the synchronous detector coil apply the VG91's 45.75 MHz Video IF signal into the IF stages and observe the output. A video monitor can be used to judge the performance, but an oscilloscope allows the best adjustment.

To test and align the synchronous detector:

1. Connect the VG91 to the receiver as explained in the "Basic setup For Injecting Into The 45.75 MHz Video-IF" on page 45.

2. Connect an oscilloscope to the video detector output.

3. Set the oscilloscope to view two horizontal lines of video information.

4. Set the VG91 as follows:
   a. VIDEO PATTERN to "10 Bar Staircase".
   b. RF-IF SIGNAL to "45.75 MHz Video IF".
   c. RF-IF RANGE & LEVEL to produce noise free video

5. Adjust the synchronous detector coil for best overall results:
   a. The lines between steps are as straight as possible
   b. Avoid compressing of the top or bottom steps or bowing of the middle steps.
   c. Avoid overshoots or ringing on the top edges of the steps.

Aligning Video-IFs

Today most IF stages use a SAW filter to shape the frequency response and do not require bandpass alignment. However, an adjustable coil is often used to match the SAW filter to the IF amplifier IC. This coil affects the sensitivity, not the bandpass of the IF circuits and should be aligned for best sensitivity. A few chassis still use conventional LC circuits and should be aligned for the best response.

The VG91 provides a dynamic system to align the IF bandpass of any 45.75 MHz video-IF. The Multiburst Bar Sweep and Luma/Chroma Bar Sweep patterns provide a dynamic check of the frequency response.

To align Video-IF stages

1. Connect the VG91 to the receiver as explained in the "Basic Setup For Injecting Into The 45.75 MHz Video-IF" on page 45.

2. Adjust the RF-IF RANGE & LEVEL to produce noise free video.

3. Connect an oscilloscope to the video detector output or to the 1st video amplifier ahead of any frequency compensation or peaking network.

4. Set the oscilloscope to view 1 or 2 horizontal lines of video signal.

5. Set all video-IF traps. (See "Testing and aligning IF Traps" page 49.)

6. **Conventional LC bandpass coils:**
   Coils in the last stage (detector tuning coils):
   1. Use the 10 Bar Staircase pattern.
   2. Adjust for best video to sync ratio.
   3. Adjust for largest amplitude signal without compression.

   Bandpass coils in the 1st IF stage:
   1. Use the Multiburst Bar Sweep video pattern.
   2. Adjust for maximum sensitivity using the lowest RF-IF LEVEL setting that produces an output.
   3. Increase RF-IF LEVEL to normal level and readjust for good bandwidth.
   4. Increase the amplitude of the high frequency bars until sync compression, or ringing on the low frequency bars begins.
   5. Set the remaining adjustments for the best response with minimum sync compression, ringing and overshoot.
   6. Repeat steps 2-5 for the best response.

   SAW filters:
   1. Connect a DVM to the IF AGC test point.
   2. Set the RF-IF Range to "Lo"
   3. Increase the RF-IF LEVEL until the AGC voltage begins to change.
   4. Adjust the SAW matching coil to peak the AGC voltage change.

Follow these guidelines for all video-IF alignment with the Multiburst Bar Sweep pattern:

1. The lower frequency square waves must show the least amount of overshoot and ringing
2. No bar should drop below the imaginary black level.
3. No bar should be larger in amplitude than the one to its left.
4. No bar should be missing or greatly reduced in amplitude.

NOTES:
1) The Multiburst Bar Sweep shows imperfections in IF performance that cannot be seen with other forms of IF tests or alignment methods. Many of these imperfections are inherent in the design of the IF stages. Therefore, align for the best results instead of for perfection.

2) IF bandwidth and response varies among receivers. Typically IF response extends to 2 or 3 MHz before beginning to roll off. You can figure out the normal rolloff of the IF stages by comparing the Multiburst Bar Sweep response to a sweep generator curve in the manufacturer's alignment instructions.

3) Use the Luma/Chroma and Sweep pattern to performance test wideband color receivers. This pattern provides a more detailed response analysis of the IF frequency bandpass for the chroma frequencies. See "Testing the IF chroma bandpass" section on page xx for more information on performance testing wideband color IF receivers.

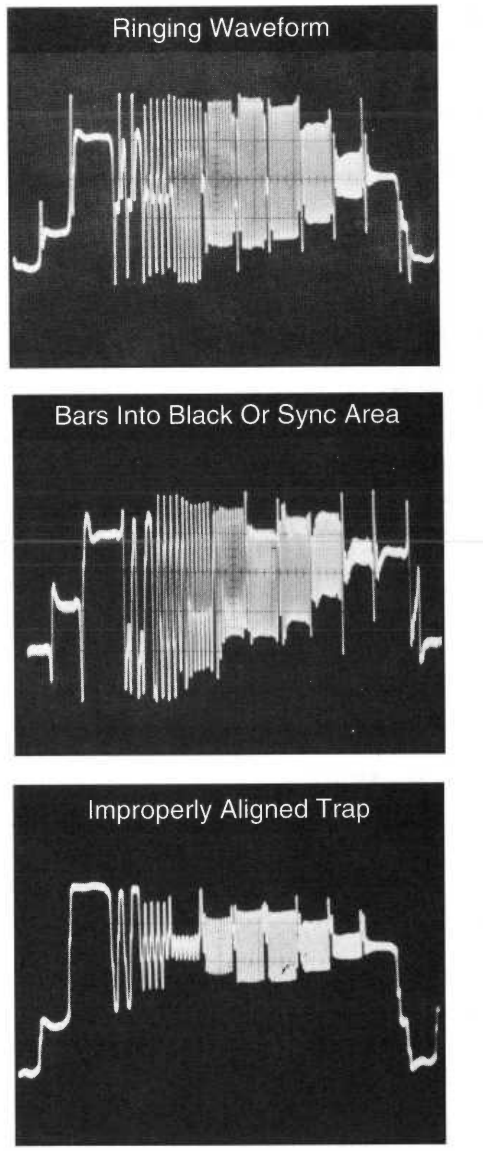


Fig. 53 - Examples of improperly aligned IF stages.

VIDEO STAGES

Most TV-video products, including VCRs, monitors and television receivers, process the luminance and chroma portion of the demodulated video signal. Some video products, such as monitors, only have video stages and rely on some other component to tune and demodulate the RF signal. The VG91's video patterns provide special reference signals to analyze and performance test any NTSC video stage. Some patterns are specifically designed to performance test the luminance stages, while others test the chroma stages.

To provide the best test of the video stages you should apply the VG91's signal as close to the video circuits as possible. Otherwise defects in earlier stages may cause degraded performance. When possible, apply the signal to the units Y/C input. If the unit does not have a Y/C connector, use the VIDEO LINE IN jack. Only use the RF input if the chassis does not have a Y/C or VIDEO IN connector.

Basic setup for performance testing video stages:

1. Connect the VG91 to the input of Video system.
   a. Use the Y/C input if possible.
   b. Use the VIDEO LINE IN jack if the video system does not have a Y/C connector.
   c. Only use the RF input if the video system does not have a Y/C connector or a VIDEO LINE IN jack.

2. Set the video system to select the VIDEO LINE IN jack input signal.

3. Set the VG91 VIDEO PATTERN switch to match the test to be performed.

4. Monitor the output of the chroma or luminance circuits with an oscilloscope or by observing the output on the system's CRT.

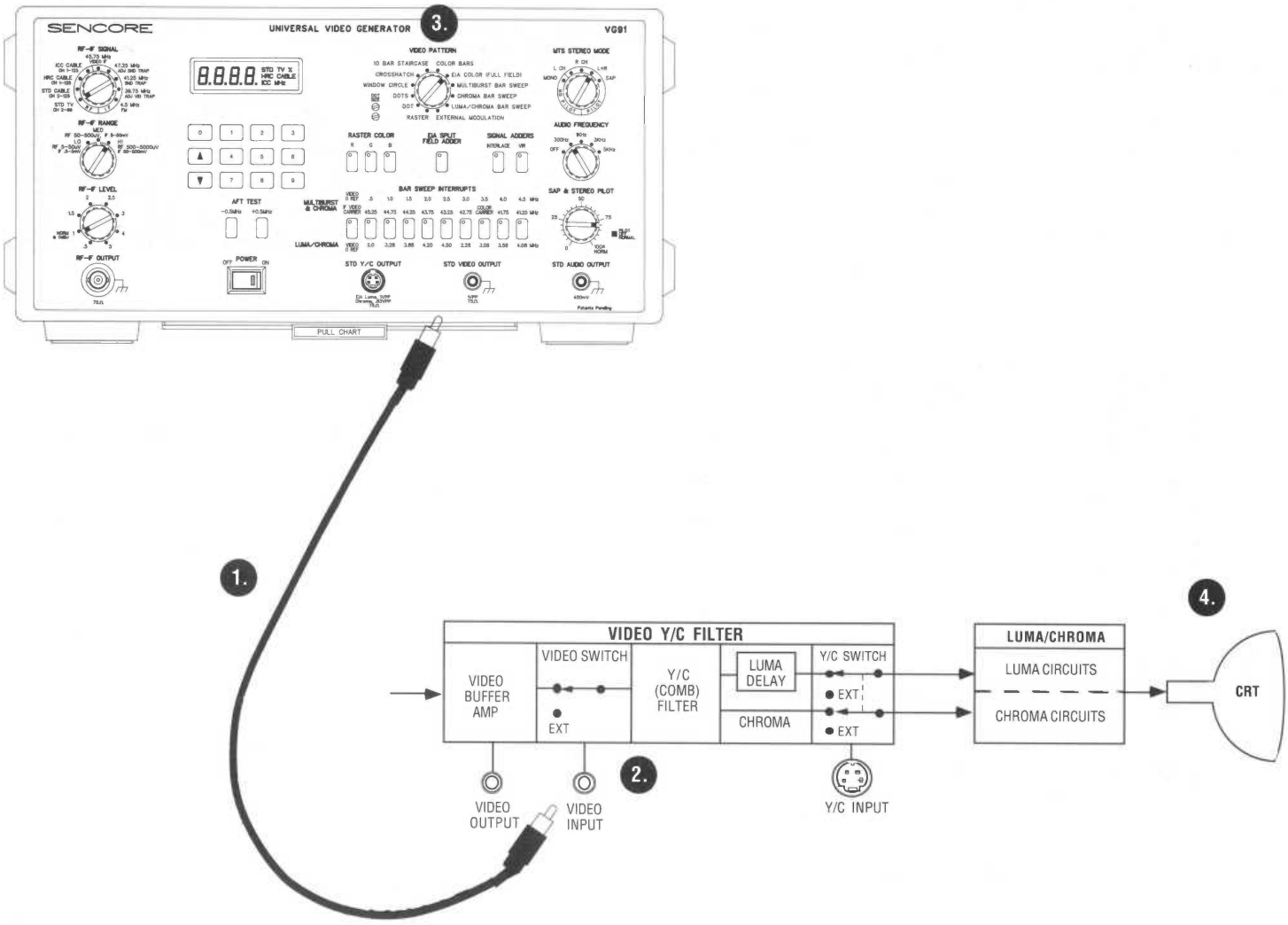


Fig. 54 - Basic setup for testing the video stages.

Testing Luminance Frequency Response

Use the Multiburst Bar Sweep pattern to test the frequency response of the video luminance stages. This pattern checks the video luminance circuits over their entire frequency range to locate any stage that may be restricting the video resolution.

All the frequency bars at the VG91's STD VIDEO OUTPUT and Y/C OUTPUT have the same amplitude. Stages that have an ideal flat frequency response will reproduce all of the Multiburst Bar Sweep bars at the same level. Most video stages, however, will reduce amplitude of the higher frequency bars. The amount of reduction depends on the circuit design. A comb filter, for example, has a much higher luminance response than conventional, passive luma/chroma filters. Video stages that use high frequency peaking will show increased amplitude of the high frequency bars.

Some service literature references "lines of resolution." A line of resolution is a measure of video frequency response and is the smallest horizontal detail that can be reproduced. Lines of resolution can be determined from the Multiburst Bar Sweep pattern by noting the highest frequency bar that still shows individual lines. Multiply the frequency of this bar (marked in MHz by the MULTIBURST BAR SWEEP INTERRUPT button) by 80 to convert to the approximate lines of resolution. A 2 MHz bar, for example, equals 160 lines of resolution.

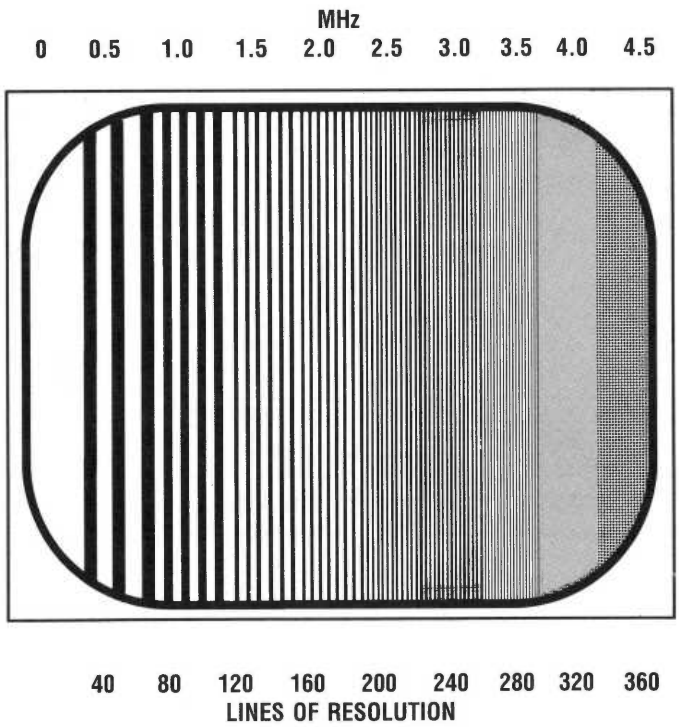


Fig. 55 - Use the Multiburst Bar Sweep pattern to determine "lines of resolution".

Testing Chroma Frequency Response

The Chroma Bar Sweep pattern provides a reference for testing the chroma stages. This pattern tests the chroma frequency response over the normal 1 MHz bandwidth of the color processing circuits, centered at 3.58 MHz.

The Chroma Bar Sweep pattern has three bars that are produced at equal amplitudes from the VG91's Y/C and STD VIDEO outputs. The balance between the upper and lower bars shows the bandpass and alignment of the color processing circuits. An ideal chroma circuit will reproduce the upper and lower bars with equal amplitude and saturation. A reduction of the 4.08 MHz bar shows the upper chroma sideband is reducing the signal, while a reduction of the 3.08 MHz bar shows the lower chroma sideband has reduced levels.

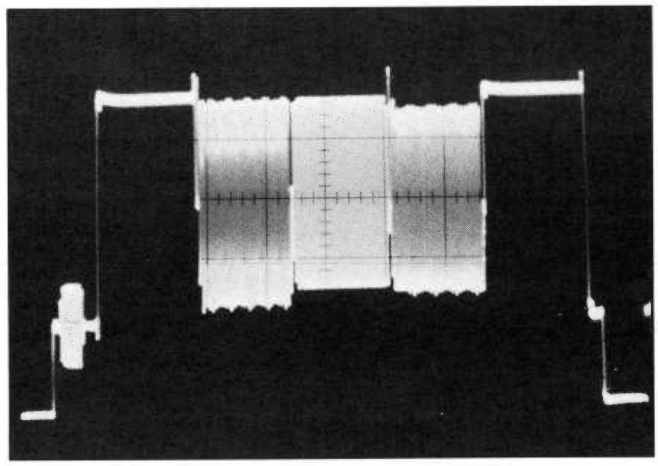


Fig. 56 - The Chroma Bar Sweep pattern tests the operation and frequency response of color circuits. Ideally all bars are reproduced equally.

Testing And Aligning Y/C (Comb) Filters

Video systems must separate the luminance (Y) portion of a composite NTSC video signal from the chroma (C) portion of the video signal to prevent picture interferences. Chroma signal in the luminance stages will cause beat interference, and luminance signals that get into the color circuits will cause color swirls on detail portions of the picture. Conventional separation of the luminance and chroma signals use passive bandpass filtering, while modern stages use a comb filter. See Appendix E for details on how comb filters work.

The VG91's Luma/Chroma Bar Sweep pattern offers an improved method to test and align all Y/C separation circuits, compared to other methods and patterns. Use this pattern to: 1) test how well the chroma and luminance information is separated from each other; 2) test the frequency response of the

separated luminance and chroma signals, and 3) optimize the adjustments for the best separation and response.

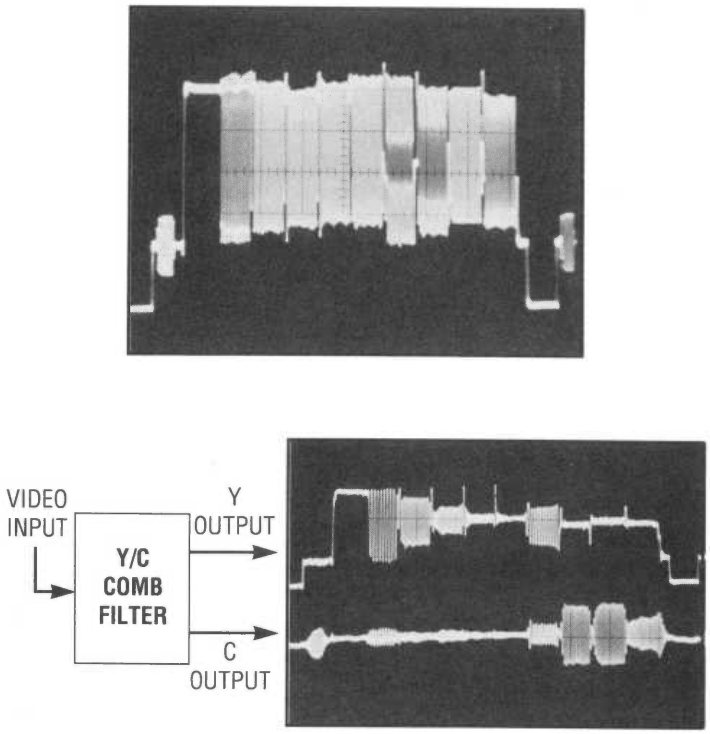


Fig. 57 - The luma/Chroma Bar Sweep pattern tests the frequency response and separation of Y/C (Comb) filters.

To test and align a Y/C (comb) filter:

1. Connect the VG91 to the chassis as explained in the "Basic setup for performance testing video stages" on page 52.

2. Select the LUMA/CHROMA BAR SWEEP pattern.

3. Connect one probe of a dual trace oscilloscope to the luminance output of the Y/C filter and the other probe to the chroma output of the Y/C filter.

4. Set the oscilloscope to view 1 or 2 lines of horizontal video information.

5. a. Observe the luminance output on the oscilloscope.
   b. Adjust the control in the luminance path to minimize the amount of chroma signal in the 2.28-4.08 MHz bars while obtaining the best luminance response.

6. a. Observe the chroma output on the oscilloscope display.
   b. Adjust the control in the chroma path to minimize the amount of luminance signal in the 2.0-4.5 MHz bars while obtaining best chroma response.

Conventional filters restrict the luminance bandwidth to about 3.0 MHz, but comb filters typically offer a luminance bandwidth to 4 MHz and extend the chroma bandwidth to 1.3 MHz below the 3.58 MHz color carrier. All the frequency bars at the VG91's STD VIDEO OUTPUT and Y/C OUTPUT have the same amplitude. Therefore, the 0 to 4.2 MHz bars should be visible at the comb filter's luminance output, with the amplitude of the 3.28, 3.88 and 4.2 MHz bars gradually decreasing. The 2.28 to 4.08 MHz bars should be visible at the comb filter's chroma output. These bars should all be similar in amplitude, with perhaps a slight reduction in the 2.28 MHz bar.

You can use the BAR SWEEP INTERRUPTS to quickly identify poor separation between the luminance and chroma outputs. Turn off the luminance bars while observing the chroma waveform, or the chroma bars on the video system's CRT. If the chroma bars change as you turn the luminance bars on or off, some luminance signal is getting into the chroma circuits. If the luminance bars change as you turn the color bars on and off, some chroma is getting into the luminance circuits.

Testing Y/C (S-Video) Input Circuits

Many video systems have an "S Video" (or Y/C) connector. The S-Video connector allows separate luminance and chroma signals to be applied to or taken from the chassis. High performance, consumer video recorder formats, such as S-VHS, S-Beta and Hi-8, offer increased luminance bandwidth. In order to take full advantage of this increased bandwidth, the luminance and chroma signals are never mixed. Instead, they are applied directly to luminance and chroma circuits of a monitor.

Separate Y and C signals (as opposed to a composite video signal) allow wider luminance bandwidth and better picture detail. Separate signals also reduce the rainbow swirls and beat interference ("dot crawl" or "color bleeding") that are caused when the luminance and chrominance signals are combined and separated. Use the VG91's Luma/Chroma Bar Sweep Pattern to test the Y/C inputs of video systems.

To Test Y/C (S-Video) Input Circuits:

1. Connect the supplied Y/C TEST CABLE between the VG91's STD Y/C OUTPUT and the Y/C INPUT of the video system.

2. Set video system to Y/C (S-Video) input.

3. Set the VG91 as follows:
   a. VIDEO PATTERN to "Luma/Chroma Bar Sweep".
   b. All BAR SWEEP INTERRUPTS on. (All buttons in.)
   c. INTERLACE off. (Button out).

4. Monitor the output of the chroma or luminance circuits with an oscilloscope, or observe the output on the CRT display of the system.

The S-Video input circuits should reproduce up to 400 lines of resolution. Because all the Luma/Chroma Bar Sweep frequency bars at the VG91's Y/C OUTPUT are the same amplitude, you should see distinct vertical stripes in the 4.2 MHz and 4.5 MHz luminance bars of the Luma/Chroma Bar Sweep pattern. The S-Video input circuits also should reproduce the full I and Q color sidebands. You should see distinct color stripes in the 2.28, 3.58, and 4.08 MHz bars of the Luma/Chroma Bar Sweep pattern. If you view the signals in the luma or chroma circuits on an oscilloscope all the Luma/Chroma Bar Sweep bars should be equal or nearly equal in amplitude.

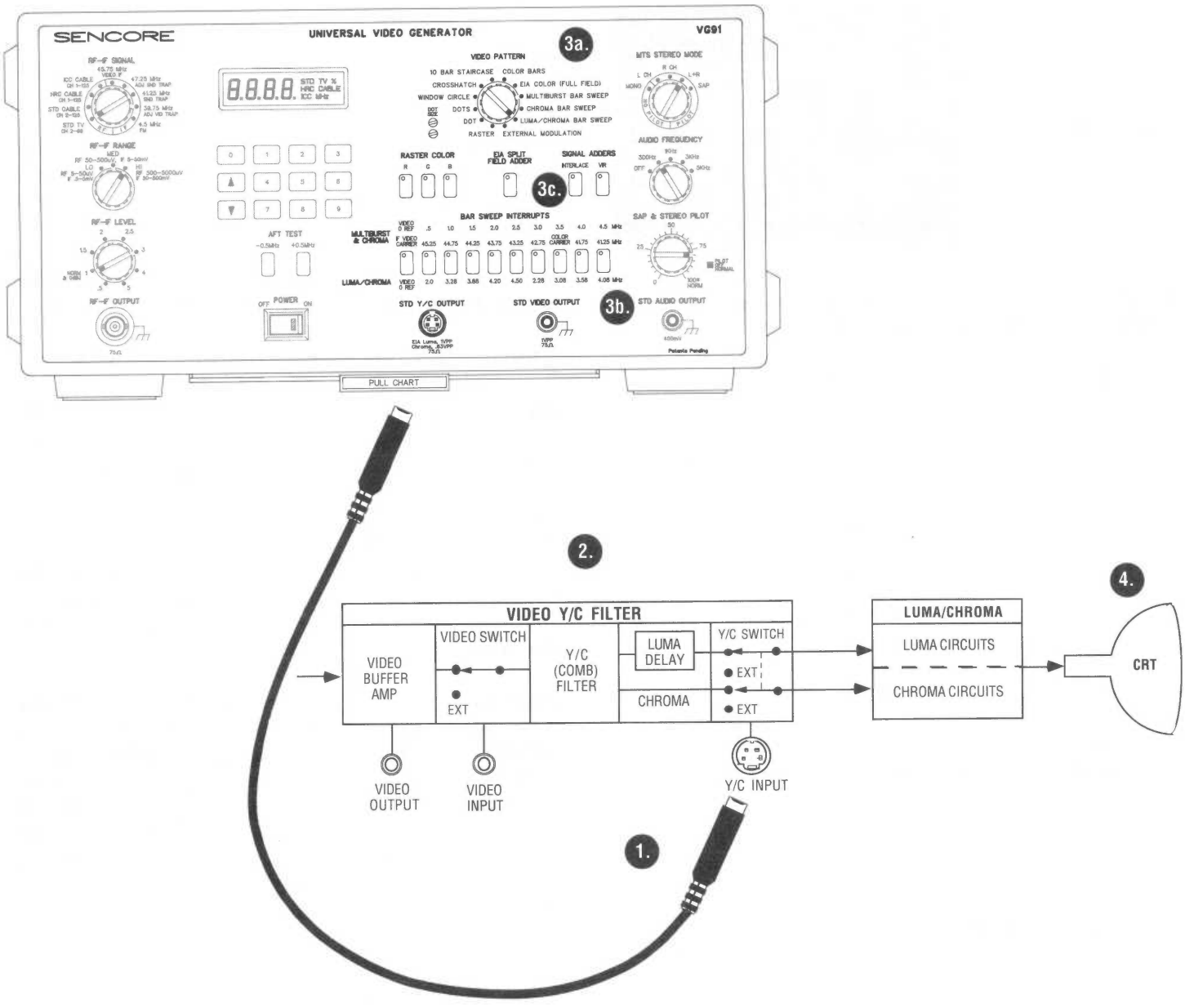


Fig. 58 - Use the STD Y/C Output to test the circuits that receive S-Video input signals.

Testing Chroma Circuits

The chroma circuits decode and recover the color information and 3.58 MHz subcarrier. The recovered color signals (R-Y, B-Y and G-Y) are matrixed with the luminance signals to drive the CRT guns. Before the color information can be recovered, the 3.58 MHz subcarrier must be reinserted at the exact frequency and phase of the burst. Problems in the chroma amplifiers, 3.58 MHz oscillator, demodulator, matrix amplifiers or any associated circuit can cause improper tint, or missing colors.

The VG91 provides 2 standard color bar patterns to test, troubleshoot and align color circuits in monitors, receivers, and recorders: (1) Color Bars (gated rainbow) pattern and (2) EIA Color Bars. These patterns provide color bars at different phases and amplitudes to dynamically test chroma processing circuits. Apply these signals to the input of a monitor or receiver and look for proper color. To test a video recorder, record the signal and view the playback signal on a monitor.

The Color Bars (gated rainbow) pattern produces 10 visible color bars with each bar a different tint. This pattern has been used by service technicians for many years and provides a quick check of the chroma demodulators and tint control. The colors should range from yellow-orange on the left, to green on the right. Each color bar represents a 30 degree phase shift from the adjacent bar. Tint or hue controls can normally produce a 60 degree phase shift, so you should be able to move each color bar left or right one bar. Missing or improper colors indicate a problem in the color circuits. This pattern contains a burst and properly saturated colors and can be used for most Manufacturer's alignment procedures.

The EIA Color Bar produces 6 color bars and grey. The color bars include the primary colors (red, blue, and green) and secondary colors (yellow, cyan, and magenta). The color bars sample the full 360 degree color spectrum and each bar is produced at full saturation to match most service literature. Missing or improper colors indicate a color circuit problem.

Note: Alignment procedures vary between manufacturers. Use either the Color Bars or EIA Color Bar pattern and follow specific alignment procedures for the video system you are servicing.

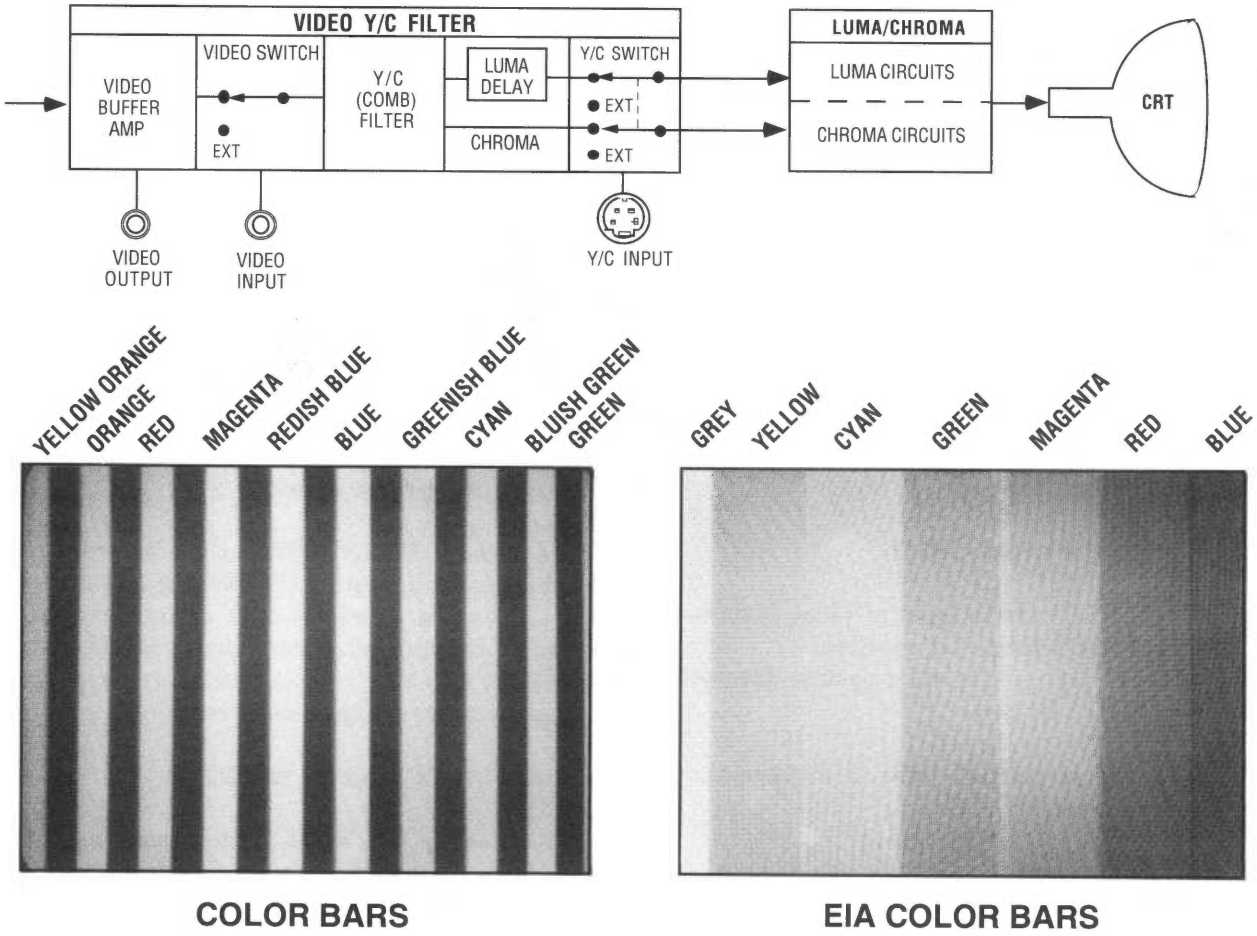


Fig. 59 - The color bar patterns test color circuits for proper color demodulation.

To test for proper color demodulation and tint range:

1. Connect the VG91 to the chassis as explained in the "Basic setup for performance testing video stages" on page 52.

2. Set the video equipment to produce an output on a CRT monitor.

3. Select either COLOR BARS or EIA COLOR pattern.

4. Check the CRT monitor for proper color bars as shown in **Figure 56.**

Testing And Adjusting The Color Killer

The color killer disables the color circuits during a black & white video signal. This prevents undesired color noise in the picture. The color killer looks for the presence of the color burst on the video signal and disables the color amplifiers if the burst is missing. Many color circuits have a color killer adjustment that sets the threshold level that activates the color killer. If the color killer is set incorrectly color noise may occur in a B&W picture, or a color signal may be reproduced in B&W.

The VG91 provides a quick, dynamic check and adjustment of color killer circuits. All of the VG91's color patterns contain a color burst at the proper amplitude and timing (many generators insert an extra color bar for burst and don't duplicate standard broadcast signals). The VG91's B&W patterns, however, omit the burst and should never show color.

The Multiburst Bar Sweep pattern provides an especially good test of the color killer since it produces video frequencies that are near the color frequencies. Simply test and adjust the color killer for proper color on the color patterns and no color on the Multiburst Bar Sweep pattern.

To test and align the color killer:

1. Connect the VG91 to the input of Video system.
   a. Use the VIDEO IN jack if possible.
   b. Use the RF input if the video system does not have a VIDEO IN jack.

Do not use the Y/C connector, since this connection may be after the color killer circuit.

2. Set the video system to select the input signal and monitor the output on the system's CRT or on a monitor connected to the VIDEO OUT jack.

3. Set the VG91 VIDEO PATTERN to "Color Bars" or "EIA Color Bars".

4. Observe the output for proper color.

5. Select the 10 BAR STAIRCASE pattern.

6 You might see momentary color rainbowing in some bars, but all bars should quickly turn to B&W and remain B&W. Adjust the color killer control for the least delay.

7. If the 10 BAR STAIRCASE pattern continues to show color rainbowing, adjust the color killer until the display turns to B&W only.

8. Repeat steps 3-7 as necessary.

Adjusting CRT Drive And Screen Controls

Proper setting of the CRT drive and screen controls is needed to produce a good black and white display without color contamination. This procedure is often called "grayscale," "color tracking" or "white balance." While there are many variations in this specific procedure, most procedures adjust the drive and screen controls for a good black and white raster. The drive and screen controls affect the bias and conduction of the individual color guns in the CRT.

The screen controls have the greatest affect on the bright portions of the picture. They are adjusted so that white areas of the picture show no color shade. Adjusting the screen controls too high will over-bais the gun and cause color shading in the black picture areas.

The drive controls set how much signal is applied to each gun. Set these controls to get a good balance of the three colors on all brightness levels between black and white. These controls have the most visible affect on the gray picture areas.

The 10 BAR STAIRCASE pattern provides a dynamic reference for adjusting CRT screen and drive controls. It allows you to adjust CRT setup controls, in most cases, without using the chassis setup switches and without shorting circuit points as described in the manufacturer's alignment procedures.

To set black & white tracking:

1. Connect the VG91 to the chassis as explained in the "Basic setup for performance testing video stages" on page 52.

2. Set the video equipment to produce an output on a CRT monitor.

3. Select the 10 BAR STAIRCASE pattern.

4. Preset the chassis controls as follows:
   a. CRT screen and drive controls to minimum
   b. Front-panel brightness and contrast controls to midrange.

5. Increase the red screen control until the black bar on the left of CRT begins to show red, then decrease the setting until the red just goes away.

6. Repeat step 5 for the blue and green screen controls.

7. Fine tune the screen controls until the white bar on the right of the screen is pure white with no shade of color.

8. Adjust the drive controls until the center grey bars show no color shading.

9. Repeat steps 5 - 8 until no bars show color shading.

Note: If careful adjustment of the controls fails to remove color in the bars, test the CRT for proper color tracking.

Picture Centering And Linearity

Video monitors (and television receivers) have adjustments to properly size and shade the raster. Common adjustments include yoke alignment, vertical height & linearity, horizontal width and centering and pincushion. Using the Window Circle pattern with the manufacturer's alignment instructions greatly simplifies these adjustments. The Window Circle pattern is really several patterns in one. Each part tests a specific portion of the raster.

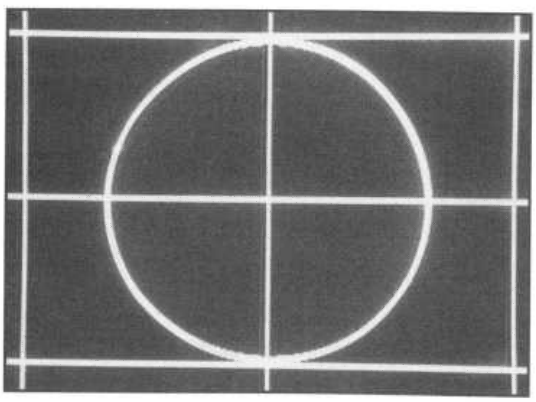


Fig. 60 - Use the Window Circle pattern to make picture centering and linearity adjustments.

Use the following guidelines to decide which portion of the Window Circle pattern to observe:

1. Use the vertical and horizontal lines that cross in the middle of the raster to make centering adjustments. Adjust the controls to center the single cross horizontally and vertically within the screen.

2. Use the top, middle and bottom horizontal lines to align the deflection yoke. Rotate the yoke until the lines are straight across the screen.

3. Use the outside box to make vertical height, horizontal width and other deflection adjustments. First, center the pattern. Then, adjust the deflection controls to position the lines at a distance from the corresponding CRT edge that is equal to approximately 5% of the screen size. Readjust the controls as needed to position all lines an equal distance from their corresponding side.

4. Use the circle portion of the pattern for scan linearity adjustments, such as vertical linearity, pincushion etc. Adjust the controls for a round and centered circle.

Note: The Crosshatch pattern is also helpful in evaluating or adjusting deflection linearity or pincushion.

Setting Color Purity And Convergence

CRT displays require proper setup to display proper color. The VG91 provides several video patterns that allow you to completely set the purity and convergence adjustments.

Follow the manufacturer's specific instructions for the step-by-step procedure using these general guidelines:

PURITY

1. Use the RASTER pattern.
2. Select the RASTER COLOR specified by the manufacturer. If none is specified, select red.
3. Rotate the appropriate purity ring for uniform color.

STATIC (CENTER) CONVERGENCE

1. Use the DOT pattern.
2. Rotate the static magnets until the dot is a pure white without any color fringing.

DYNAMIC CONVERGENCE

1. Use the DOTS pattern or CROSSHATCH pattern.

2. Adjust for pure white dots or lines without any color fringing.
3. Use the CROSSHATCH pattern for the entire convergence procedure on one-gun CRTS that have no electronic convergence controls. The interaction between yoke positioning and the adjustments of the magnets is easier to see using the Cross Hatch pattern.

Note: The static center convergence may slightly affect the dynamic convergence adjustments so it may be necessary to check it again during the convergence process.

Testing VIR Circuits

Some video systems use the Vertical Interval Reference (VIR) portion of the broadcast signal to control the automatic tint and automatic color level circuits. A standard VIR signal can be added to any of the VG91's internally generated video patterns to test, troubleshoot and align VIR circuits.

The first step in testing a VIR controlled stage is to confirm its operation without the VIR control. This is done by turning both the receiver's VIR switch and the VG91's VIR switch off. Then, apply the color patterns and confirm that the color stages operate correctly using the performance tests explained earlier in this section. Adjust or repair stages if necessary. After you have confirmed proper non-VIR operation you are ready to test the VIR controlled circuits.

To test the VIR controlled circuits:

1. Connect the VG91 to the chassis as explained in the "Basic setup for performance testing video stages" on page 52.

2. Set the video equipment to produce an output on a CRT monitor.

3. Turn the VG91's VIR switch off.

4. Turn the VIR switch in the chassis on. The chassis VIR indicator should remain off, and no change in the tint or color should be seen.

5. Set the user-preference VIR controlled tint and color level controls to mid-range.

6. Turn the VG91's VIR switch on. The chassis VIR indicator light should come.

7. Confirm that the manual (non-VIR controlled) tint and color level controls have no effect on the color.

8. Adjust the VIR controlled tint and color level controls for the correct color level and tint.

If the performance tests indicate problems in the VIR circuit, use an oscilloscope to check the timing of the control pulses applied to the VIR detectors. The control pulses must be timed properly to sample the VIR signals. Refer to the manufacturer's service literature for additional information on circuit operation and troubleshooting procedures.

Using The EIA Color Pattern With A Vectorscope

The EIA Color Bars video pattern produced by the VG91 can be used with a vectorscope to test and align video equipment that must process video signals. One application is to test the record circuits of a camcorder, VCR, or VTR. In this application, record the EIA Color Bars pattern. Then view the playback signal with the vectorscope. The vectorscope will show any phase or amplitude changes that were introduced by the record/playback process.

Figure 61 shows the screen of a vectorscope. The vectorscope screen has markings (small boxes) for each part of the EIA Color Bar pattern. These boxes show the correct position of the color burst, the six color bars, and the -I and Q bars. Color saturation and tint are correct if the vectors fall inside the corresponding boxes on the vectorscope graticule.

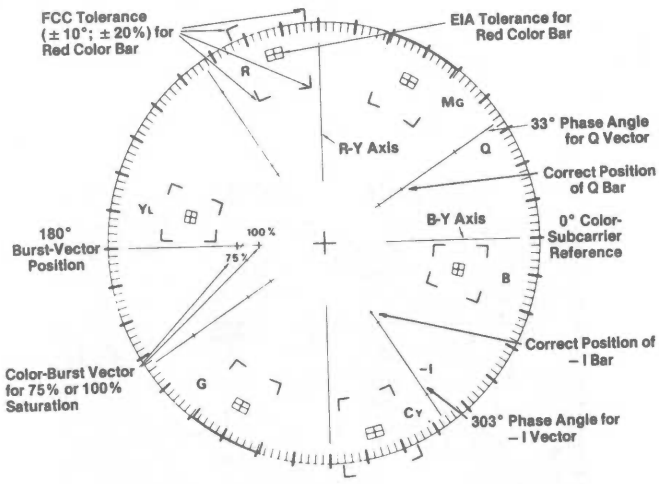


Fig. 61 - Each part of the EIA Color Bars signal should fall inside the designated boxes.

AUDIO STAGES

Audio Performance Tests

All television receivers and most VCRs can receive the audio portion of the television RF signal. Additionally, many receivers have MTS decoders and can receive stereo and Secondary Audio Program (SAP) audio signals. Problems in the tuner, IF stages, sound detector or MTS decoder can affect the quality of the recovered audio signal. A full performance test of a stereo TV RF receiver includes the following tests: 1) mono operation, 2) stereo operation, 3) stereo separation, 4) stereo signal-to-noise test, 5) SAP operation, 6) SAP signal-to-noise test, 7) SAP threshold test. These tests are discussed in more detail in the following sections.

Over-the-air signals cannot be used to performance test an MTS receiver because they are constantly varying in separation and signal strength. The VG91 UNIVERSAL VIDEO GENERATOR provides a controlled signal to accurately and reliably test MTS stereo receivers. The performance tests should be made by applying a signal into the tuner. This will check the entire receiver's audio circuits under actual operating conditions. Any RF channel may be used to check the operation of the audio stages. As with the video performance tests, a quick operational test of the mono & stereo operation should be made before and after a receiver repair.

Basic setup for audio performance tests:

1. Connect the RF cable between the VG91's RF-IF OUTPUT and the tuner's RF input.

2. Set the VG91 as follows:
   a. RF-IF SIGNAL to "STD TV" or "Cable".
   b. Select the desired channel.
   c. RF-IF RANGE to "Hi".
   d. RF-IF LEVEL to "1".
   e. VIDEO PATTERN to "Raster", and turn off all colors for a black raster.
   f. SAP & STEREO PILOT to "100%", unless otherwise specified.

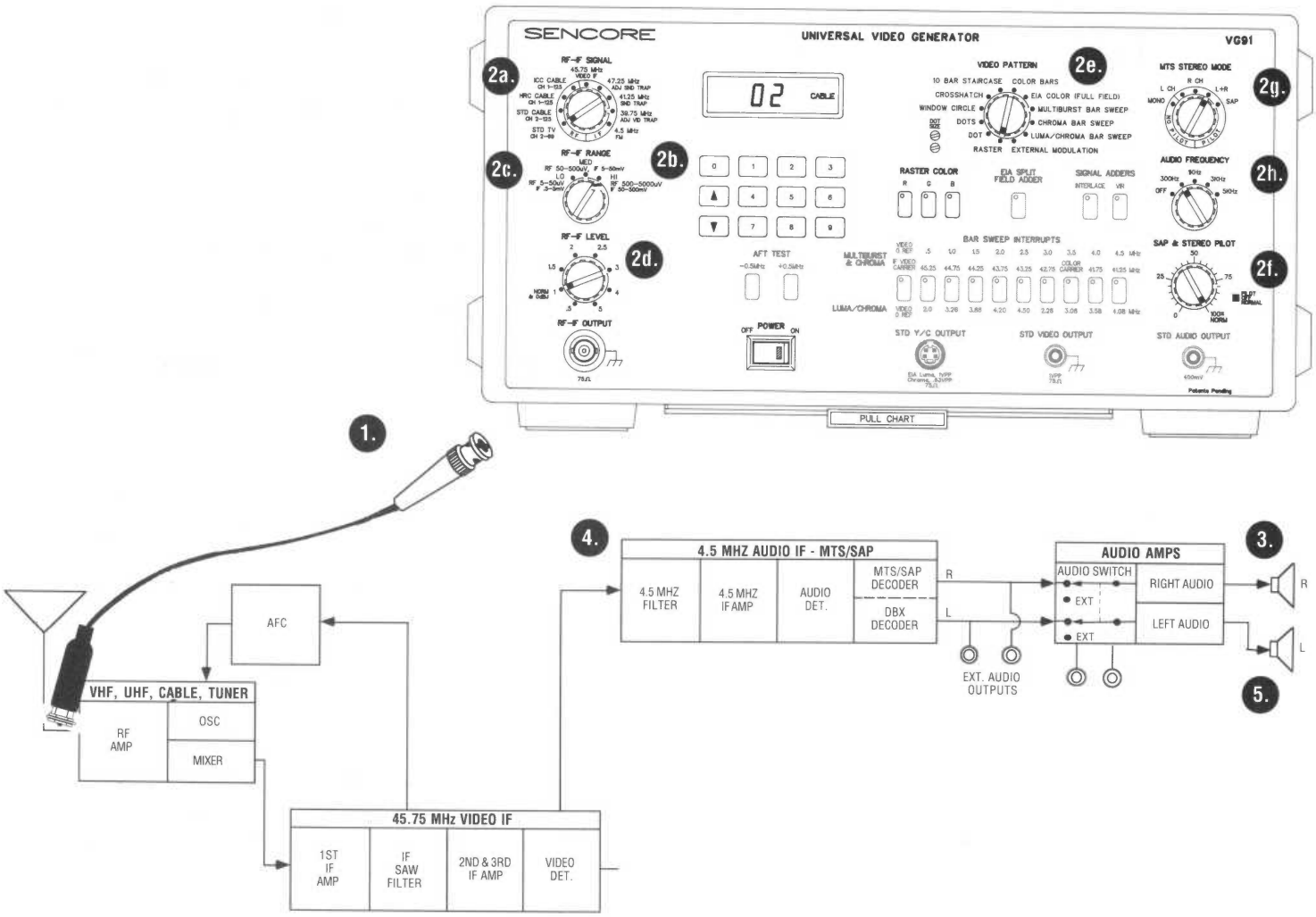


Fig. 62 - Basic set-up for audio performance tests.

g. MTS STEREO MODE to specified setting.
h. AUDIO FREQUENCY to specified setting.

3. Monitor the AUDIO OUT jacks of the receiver using either an oscilloscope or an audio voltmeter.

4. Set the receiver as follows:
   a. Select "antenna" or "tuner" input.
   b. Select TV or Cable mode & channel corresponding to VG91.
   c. Set receiver to "Mono" audio operation.

5. Check the output for proper results.

Mono And Stereo Operation

This test checks the ability of the stereo indicator and stereo circuits for turn on. It also checks for a normal output from both audio channels.

Mono and stereo receivers:

1. Set the VG91 and tuner as explained in the section "Basic setup for audio performance tests" on page 60.

2. Set the receiver for mono audio operation.

3. Monitor the output for proper audio
   a. Check for an equal output from the both the left and right audio channels of a stereo system.
   b. If the levels are different, adjust the balance control, or the internal gain controls for each channel to make the levels the same.

Stereo receivers only:

4. Switch the MTS STEREO MODE to "L + R".

5. Set receiver for stereo audio operation. Check for an equal output from the both the left and right audio channels, and that the stereo indicator is on.

Stereo Separation Test

This test checks how the receiver can reproduce a signal in one channel while rejecting the signal in the other channel. The modulation is set to produce a signal in just one channel. Any signal that appears in the other channel is crosstalk and indicates poor separation. The best separation occurs when the difference between the two audio output channels is the greatest.

Many factors cause poor stereo separation: a noisy signal, improper IF alignment, a defect or misaligned the stereo decoder, a defective matrix, a defective or misaligned dBx decoder, and even a bad power supply can cause poor stereo separation.

Stereo separation should be tested at two different audio frequencies because the dBx noise reduction circuits process low frequencies differently than high frequencies. Thus, problems can develop that affect the high frequency separation but do not affect the low frequency separation and visa versa. The VG91 provides several audio frequencies to check both low frequency and high frequency separation.

To test stereo separation:

1. Confirm that the receiver passes the Stereo Operation test and that both output levels are the same.

2. Set the VG91 as follows:
   a. AUDIO FREQUENCY to "300 Hz".
   b. MTS STEREO MODE to "L Ch".

3. Select "Stereo" audio mode on the receiver.

4. Measure the output voltage at both the left and right audio outputs.

5. Calculate the separation using the formula:

$$\text{Separation (dB)} = 20 \text{ Log } \frac{\text{left channel volts}}{\text{right channel volts}}$$

6. Repeat steps 4 and 5 with the MTS STEREO MODE set to "R Ch".

7. Repeat steps 4 - 6 with the AUDIO FREQUENCY set to "3 kHz" and "5 kHz".

Most MTS receivers should produce 20 dB or more of stereo separation at 300 Hz. This may typically drop to 15 dB at 5 kHz. Consult the manufacturer's separation specs for the receiver you are servicing. If the receiver's performance is lower than specified, the stereo decoder may need alignment.

Stereo Frequency Response

All TV RF receivers use a 75 uS deemphasis network to reduce the output of the high audio frequencies. This deemphasis network reverses the preemphasis (higher audio frequency boost) that was added at the transmitter. In mono receivers the deemphasis network is after the FM detector output and in stereo receivers it is in the L+R signal path.

Problems in the RC deemphasis network or other critical audio response components will degrade the audio fidelity. The VG91 generates 4 audio test frequencies to verify that the audio circuits are properly reproducing the full range of audio frequencies.

To test stereo frequency response:

1. Confirm that the receiver passes the stereo separation test.

2. Set the VG91 as follows:
   a. MTS STEREO MODE to "L + R".
   b. AUDIO FREQUENCY to "300 Hz"..

3. Measure the voltage at either the left or right audio output.

4. Set VG91 AUDIO FREQUENCY to "3 kHz". Measure the audio output voltage.

5. Figure out the frequency response using the formula:

$$dB = 20 \text{ Log } \frac{\text{output voltage step 4}}{\text{output voltage step 3}}$$

Repeat steps 4 and 5 with the AUDIO FREQUENCY switch set to 5 kHz.

Frequency	RF out (mv)	dB reduction in gain
300	99.0	– .1 dB
1,000	90.4	– .9 dB
2,120	70.7	– 3.0 dB
3,000	57.6	– 4.8 dB
5,000	38.9	– 8.2 dB
8,000	25.6	– 11.8 dB
10,000	20.7	– 13.7 dB
15,000	13.9	– 17.0 dB

The audio output of an MTS receiver should decrease at higher audio frequencies when tested with the VG91. This decrease occurs because the deemphasis network rolls off the output because it expects audio signals to have preemphasis. The output of the VG91, however, does not have preemphasis. Therefore the audio output of the receiver should correspond to the deemphasis curve shown in Figure 64. For example, you should see an approximate reduction of 5 dB between 1 kHz to 3 kHz. If the output levels do not conform to the deemphasis curve, a problem exists in the audio circuits.

Stereo Signal-to-Noise Test

This test determines how much internal noise is being generated by the receiver's stereo circuits, from the antenna to the speakers. Excessive noise reduces the quality of the audio signal.

To test stereo signal-to-noise:

1. Confirm that the receiver passes the Stereo frequency response test.

2. Set the VG91 as follows:
   a. MTS STEREO MODE to L +R.
   b. AUDIO FREQUENCY to 300 Hz.

3. Measure the voltage at the output of either audio channel.

4. Set the VG91 AUDIO FREQUENCY to "Off". Measure the output noise voltage.

5. Figure out the signal-to-noise ratio using the formula:

$$\text{S/N Ratio (dB)} = 20 \text{ Log } \frac{\text{output voltage step 3}}{\text{output voltage step 4}}$$

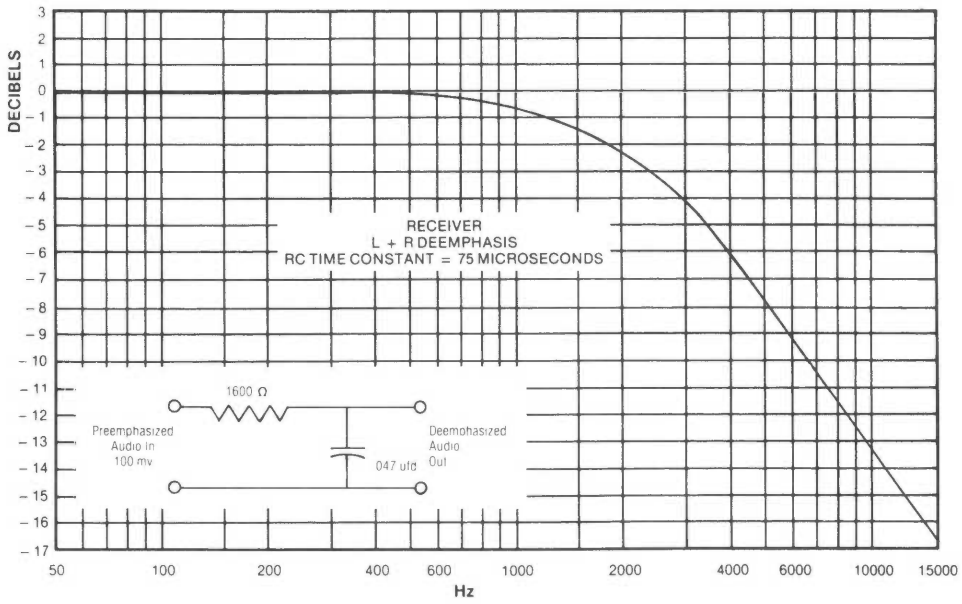


Fig. 64 - A TV receiver's audio output should follow the receivers deemphasis curve.

The signal-to-noise ratio should be greater than 33 dB. Defects in the bandpass filter, a misaligned IF, or a defective stereo or dBx decoder can cause poor signal-to-noise.

Stereo Pilot Switching Threshold Test

This test checks that the stereo circuits switch on only when a stereo signal is actually present, and that they switch off when no stereo pilot is received. If the stereo circuits are incorrectly switched on when no pilot is present, the receiver will have very noisy audio. If the pilot detect circuit fails, the TV may remain in the mono mode.

The VG91 has an adjustable stereo pilot signal that you can use to check the level at which the stereo pilot detect circuit turns on. Check both the turn-on and turn-off pilot detect levels.

To check stereo pilot switching threshold:

1. Confirm that the receiver passes the Stereo signal-to-noise test.

2. Set the VG91 as follows:
   a. MTS STEREO MODE to "L + R".
   b. AUDIO FREQUENCY to "Off".
   c. SAP & STEREO PILOT to "100% norm".

3. Confirm that the receiver's stereo indication is on.

4. Reduce the setting of the VG91's SAP & STEREO PILOT level control until the receiver's stereo indication goes off. Note the setting of the level control. This is the pilot turn-off threshold.

5. Increase the setting of the VG91's SAP & STEREO PILOT level control until the stereo indication comes back on. Note the setting of the level control. This is the pilot turn-on threshold.

The pilot level turn-off threshold should be 50% or a little less. The pilot level turn-on threshold should be greater than 50% for reliable turn on.

SAP Operation

This test checks the ability of the Secondary Audio Program (SAP) circuits to switch on, turn on the SAP indication, and produce a normal audio output.

To check SAP Operation:

1. Confirm that the receiver passes all the stereo performance tests.
2. Set the VG91 as follows:
   a. MTS STEREO MODE to "SAP".
   b. AUDIO FREQUENCY to "1 kHz".
   c. SAP & STEREO PILOT to "100%".

3. Select the SAP mode on the receiver.

4. Check for proper audio output:
   a. The SAP indicator on the receiver should come on.
   b. A 1 kHz tone should be present at the output.

SAP Signal-To-Noise

If excessive noise enters the SAP channel the quality of the SAP audio signal is reduced. The SAP signal-to-noise test determines how much noise is generated in the receiver's SAP circuits from the antenna to the output.

To test SAP Signal To Noise:

1. Confirm SAP operation.

2. Measure the voltage at the output of either audio channel.

3. Set the VG91 AUDIO FREQUENCY to "Off". Measure the output noise voltage.

4. Figure out the signal-to-noise ratio using the formula:

$$\text{S/N Ratio (dB)} = 20 \text{ Log } \frac{\text{output voltage step 2}}{\text{output voltage step 3}}$$

   The Signal to Noise ratio should be greater than 33 dB.

SAP Switching Threshold Test

This test checks the ability of the SAP circuits to properly turn on with a SAP signal is present, and to turn off when no SAP signal is received. Both the SAP pilot detect turn on and turn off levels should be checked.

To test the SAP carrier threshold:

1. Confirm that the receiver passes the SAP signal-to-noise test.

2. Set the VG91's AUDIO FREQUENCY to "Off"..

3. Confirm that the receiver's SAP indication is on.

4. Reduce the setting of the VG91's SAP & STEREO PILOT level control until the receiver's SAP indication goes off. Note the setting of the level control. This is the pilot turn-off threshold.

5. Increase the setting of the VG91's SAP & STEREO PILOT level control until the SAP indication comes back on. Note the setting of the level control. This is pilot turn-on threshold.

The SAP carrier turn-off threshold level should be 50% or a little less for reliable operation, and the turn-on threshold should be greater than 50%.

Aligning the Stereo Decoder

Proper alignment of the MTS decoder is necessary for optimum performance. Misalignment can cause poor stereo separation, poor signal-to-noise and poor frequency response. The VG91 provides a reference MTS signal so you can properly adjust the stereo decoder for optimum performance.

To align the stereo decoder:

1. Set the VG91 and tuner as explained in the section "Basic setup for audio performance tests" on page 60.

2. Set the VG91 as follows:
   a. MTS STEREO MODE to "L CH" or "R CH."
   b. AUDIO FREQUENCY to "300 Hz".
   c. SAP & STEREO PILOT to "100%".

3. Adjust the low frequency separation adjustments to obtain maximum separation.

4. Set the VG91's AUDIO FREQUENCY to "3 kHz" or "5 kHz" as suggested by the manufacturer and set the high frequency separation adjustments for maximum separation.

Note: Terminology of separation controls varies among manufacturers. Refer to the manufacturers literature to decide which control is adjusted for separation at the low and high audio test frequencies.

You may notice some interaction between the low and high frequency separation adjustments. Adjust for the best separation at the high and low test frequencies.

Testing And Aligning The 4.5 MHz Sound IF And Detector

Problems in the 4.5 MHz sound IF or in the sound detector can cause poor audio or degraded MTS performance. The VG91 provides a 4.5 MHz FM that can be fully modulated with any of the audio MTS signals and audio frequencies. Use this signal to isolate defects in an MTS stereo receiver, or to align the sound IF or detector stages for optimum performance.

To test or align the 4.5 MHz IF/Detector:

1. Set the VG91 and tuner as explained in the section "Basic setup for audio performance tests" on page 60. Monitor the audio output with speakers.

2. Set the VG91 as follows:
   a. RF-IF SIGNAL to "4.5 MHz FM".
   b. RF-IF RANGE to "LO".
   c. RF-IF LEVEL to 1-5 mV as required.
   d. MTS STEREO MODE to "L+R".
   e. Audio Frequency to "300 Hz"..

3. Confirm a good audio output signal.

4. Decrease the setting of the RF-IF LEVEL control until noise or distortion is heard.

5. Adjust the sound IF and detector for maximum output with the least distortion.

APPENDIX A

STD-HRC-ICC Cable Channel Frequencies

Some cable systems may shift the frequency of the video and audio carriers of some or all channels. This is done to minimize the interference caused by the mixing of the carriers on the cable system. Two common carrier shift schemes are the Harmonically Related Carrier (HRC) and the Incremental Coherent (Related) Carrier (ICC or IRC). The chart includes a listing of the FCC, HRC and ICC carrier frequencies for each cable channel.

STANDARD VHF/UHF Channel Frequencies

CHANNEL	FREQ. (MHz)
VHF Channels	
2	55.25
3	61.25
4	67.25
5	77.25
6	83.25
7	75.25
8	181.25
9	187.25
10	193.25
11	199.25
12	205.25
13	211.25
Allocated UHF Channels	
14	471.25
15	477.25
16	483.25
17	489.25
18	495.25
19	501.25
20	507.25
21	513.25
22	519.25
23	525.25
24	531.25
25	537.25
26	543.25
27	549.25
28	555.25
29	561.25
30	567.25
31	573.25
32	579.25
33	585.25
34	591.25
35	597.25

CHANNEL	FREQ. (MHz)
Allocated UHF Channels Continued	
36	603.25
37	609.25
38	615.25
39	621.25
40	627.25
41	633.25
42	639.25
43	645.25
44	651.25
45	657.25
46	663.25
47	669.25
48	675.25
49	681.25
50	687.25
51	693.25
52	699.25
53	705.25
54	711.25
55	717.25
56	723.25
57	729.25
58	735.25
59	741.25
60	747.25
61	753.25
62	759.25
63	765.25
64	771.25
65	777.25
66	783.25
67	789.25
68	795.25
69	801.25

Fig. A - Listing of Standard VHF/UHF Video Carrier Frequencies.

STANDARD, HRC, ICC CABLE Channel Frequencies (MHz) (Video Carrier, MHz)

CHANNEL#	STANDARD	HRC	ICC
Low-High VHF Cable Channels			
1		72.00	73.25
2	55.25	54.00	55.25
3	61.25	60.00	61.25
4	67.25	66.00	67.25
5	77.25	78.00	79.25
6	83.25	84.00	85.25
7	175.25	174.00	175.25
8	181.25	180.00	181.25
9	187.25	186.00	187.25
10	193.25	192.00	193.25
11	199.25	198.00	199.25
12	205.25	204.00	205.25
13	211.25	210.00	211.25
Midband Cable Channels			
14	121.25	120.00	121.25
15	127.25	126.00	127.25
16	133.25	132.00	133.25
17	139.25	138.00	139.25
18	145.25	144.00	145.25
19	151.25	150.00	151.25
20	157.25	156.00	157.25
21	163.25	162.00	163.25
22	169.25	168.00	169.25
Superband Cable Channels			
23	217.25	216.00	217.25
24	223.25	222.00	223.25
25	229.25	228.00	229.25
26	235.25	234.00	235.25
27	241.25	240.00	241.25
28	247.25	246.00	247.25
29	253.25	252.00	257.25
30	259.25	258.00	259.25
31	265.25	264.00	265.25
32	271.25	270.00	271.25
33	277.25	276.00	277.25
34	283.25	282.00	283.25
35	289.25	288.00	289.25
36	295.25	294.00	295.25
Hyperband Cable Channels			
37	301.25	300.00	301.25
38	307.25	306.00	307.25
39	313.25	312.00	313.25
40	319.25	318.00	319.25
41	325.25	324.00	325.25
42	331.25	330.00	331.25
43	337.25	336.00	337.25
44	343.25	342.00	343.25
45	349.25	348.00	349.25
46	355.25	354.00	355.25
47	361.25	360.00	361.25
48	367.25	366.00	367.25
49	373.25	372.00	373.25
50	379.25	378.00	379.25
51	385.25	384.00	385.25
52	391.25	390.00	391.25
53	397.25	396.00	397.25
54	403.25	402.00	403.25
55	409.25	408.00	409.25
56	415.25	414.00	415.25
57	421.25	420.00	421.25
58	427.25	426.00	427.25
59	433.25	432.00	433.25
60	439.25	438.00	439.25
61	445.25	444.00	445.25
62	451.25	450.00	451.25

CHANNEL#	STANDARD	HRC	ICC
Hyperband Cable Channels Continued			
63	457.25	456.00	457.25
64	463.25	462.00	463.25
65	469.25	468.00	469.25
66	475.25	474.00	475.25
67	481.25	480.00	481.25
68	487.25	486.00	487.25
69	493.25	492.00	493.25
70	499.25	498.00	499.25
71	505.25	504.00	505.25
72	511.25	510.00	511.25
73	517.25	516.00	517.25
74	523.25	522.00	523.25
75	529.25	528.00	529.25
76	535.25	534.00	535.25
77	541.25	540.00	541.25
78	547.25	546.00	547.25
79	553.25	552.00	553.25
80	559.25	558.00	559.25
81	565.25	564.00	565.25
82	571.25	570.00	571.25
83	577.25	576.00	577.25
84	583.25	582.00	583.25
85	589.25	588.00	589.25
86	595.25	594.00	595.25
87	601.25	600.00	601.25
88	607.25	606.00	607.25
89	613.25	612.00	613.25
90	619.25	618.00	619.25
91	625.25	624.00	625.25
92	631.25	630.00	631.25
93	637.25	636.00	637.25
94	643.25	642.00	643.25
FM Midband Cable Channels			
95	91.25	90.00	91.25
96	97.25	96.00	97.25
97	103.25	102.00	103.25
98	109.25	108.00	109.25
99	115.25	114.00	115.25
Channel Designation Continued			
100	649.25	648.00	649.25
101	655.25	654.00	655.25
102	661.25	660.00	661.25
103	667.25	666.00	667.25
104	673.25	672.00	673.25
105	679.25	678.00	679.25
106	685.25	684.00	685.25
107	691.25	690.00	691.25
108	697.25	696.00	697.25
109	703.25	702.00	703.25
110	709.25	708.00	709.25
111	715.25	714.00	715.25
112	721.25	720.00	721.25
113	727.25	726.00	727.25
114	733.25	732.00	733.25
115	739.25	738.00	739.25
116	745.25	744.00	745.25
117	751.25	750.00	751.25
118	757.25	756.00	757.25
119	763.25	762.00	763.25
120	769.25	768.00	769.25
121	775.25	774.00	775.25
122	781.25	780.00	781.25
123	787.25	786.00	787.25
124	793.25	792.00	793.25
125	799.25	798.00	799.25

Fig. B - Listing of FCC, HRC, ICC Cable Channel Video Carrier Frequencies.

APPENDIX B

Understanding The Bar Sweep Video Patterns

Video signals contain both large and small picture objects. Large picture objects are reproduced by low video frequencies, while small objects require high video frequencies. The video circuits must pass a wide range of frequencies from nearly 0 Hz to approximately 4.0 MHz to produce a good quality picture. The VG91 provides three Bar Sweep patterns to dynamically test the performance of the video and chroma stages in a video system.

Multiburst Bar Sweep Pattern
The Multiburst Bar Sweep pattern provides 10 samples of the frequencies that the video system must process. The frequency bars are really several cycles of a squarewave. Each bar is a different frequency squarewave, beginning at 0 MHz for the left bar and incrementing in .5 MHz steps to 4.5 MHz for the right bar. One cycle of the squarewave causes a transition between black and white and produces the visible stripes on the CRT.

To properly reproduce a squarewave the correct phase and gain of all the odd harmonics must be maintained in the video stages. The harmonics of the squarewaves for each bar effectively fill the gaps between the frequency bars. This ensures that problems between the .5 MHz test frequency increments are not over looked as they might be if a sinewave were used.

Use the Multiburst Bar Sweep pattern to test and isolate frequency response problems in the stages that amplify the luminance signals.

Chroma Bar Sweep Pattern
The Chroma Bar Sweep Pattern tests the response of the chroma stages. For proper color reproduction the chroma stages must pass a 1 MHz wide band of signals between 3.0 MHz and 4.0 MHz. Poor chroma response results in no color, washed out color, or color smearing.

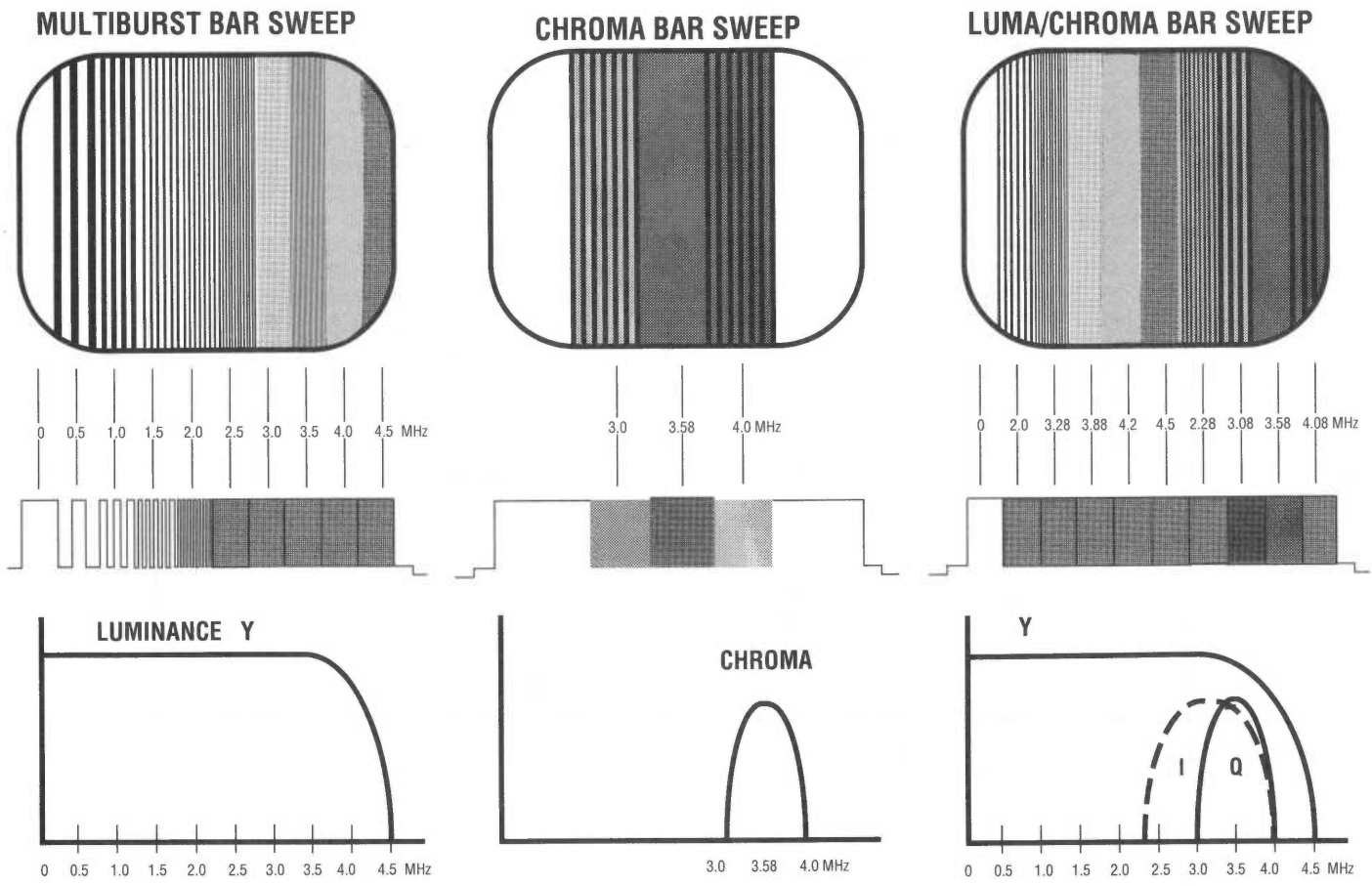


Fig. C - The Bar Sweep patterns test the bandpass responses of the luminance and chroma stages.

Three chroma frequency bars test the 1 MHz bandwidth response. The middle bar is a 3.58 MHz sub-carrier reference. It is phased to produce a cyan bar on a properly adjusted monitor. The bars to the left and right of the middle bar represent chroma signals .5 MHz from the carrier - 3.08 MHz and 4.08 MHz. These bars should show equal intensity color stripes on a wideband color monitor.

Use the Chroma Bar Sweep pattern to test and isolate problems in the chroma processing circuits, including the video-IF, comb filter, chroma bandpass circuits, and chroma demodulators.

Luma/Chroma Bar Sweep Pattern

Many of today's video systems use comb filters, wideband I color circuits, and Y/C signal inputs. These features extend the luminance and chroma bandpass and improve the picture performance. The Luma/Chroma Bar Sweep pattern is specially designed for analyzing these wideband luminance and chroma circuits.

It contains 6 frequency bars to check the luminance response from 0 to 4.5 MHz, including a 4.2 MHz bar that represents the highest transmitted luminance frequency. The Luma/Chroma Bar Sweep pattern has 4 chroma frequency bars. Three of the bars are the same as the Chroma Bar Sweep pattern. A 2.28 MHz chroma frequency bar is added to test the area where the luminance and I sideband chroma signals overlap. This bar represents the highest I chroma sideband that may be transmitted in the composite video signal.

Interpreting the Bar Sweep Patterns

All bars of the three Bar Sweep patterns are the same peak-to-peak amplitude at the VG91's outputs. Therefore, you know the video stages are passing the frequency if you see an output when you view the pattern on a CRT monitor or on an oscilloscope connected to the video system's VIDEO OUT jack.

Perhaps the best way to understand how to use each pattern is to explain what the pattern should look like when it is reproduced by an ideal 4.5 MHz wideband color monitor. Figure C shows the ideal video bandpass response and Figure D shows the relationship between the Bar Sweep Frequencies and IF response curve.

Ideally, each bar of the Multiburst Bar Sweep pattern show visible stripes. The brightness of each bar shows the relative gain. All bars should

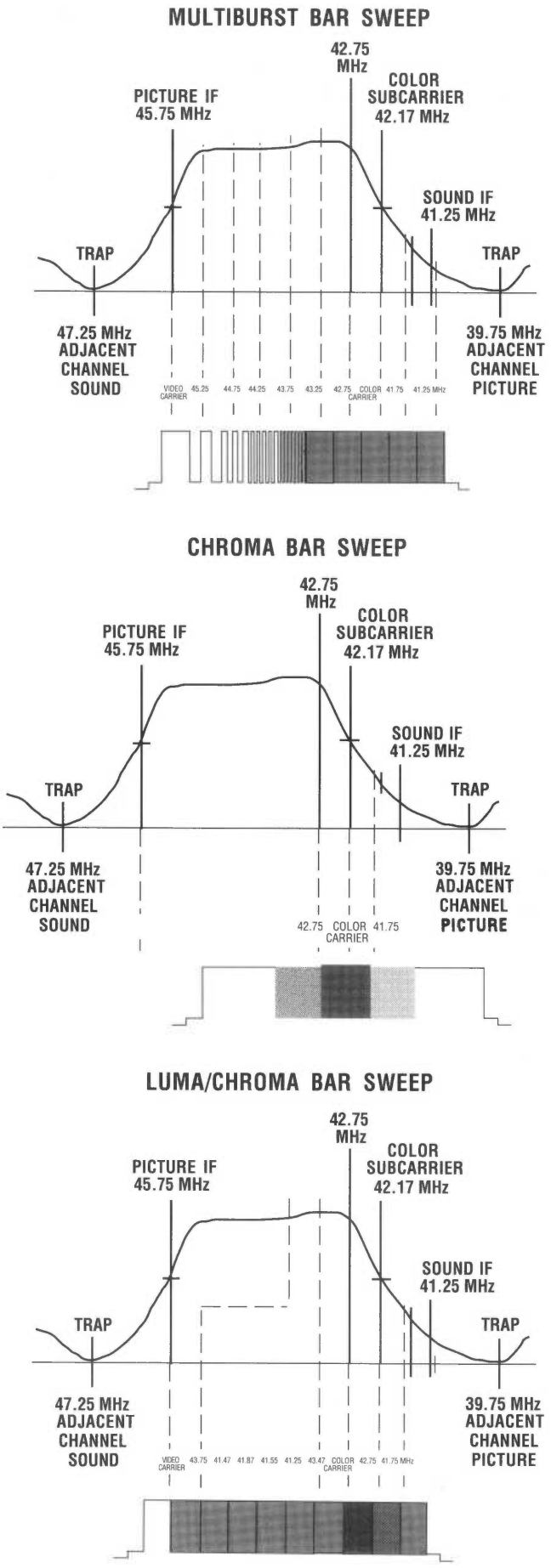


Fig. D - Relationship between the Bar Sweep frequencies and IF response curve.

turn dark simultaneously as you adjust the brightness and intensity controls. Bars that turn dark before the others, or that show no or poor detail indicate the frequency limits of the video circuits.

The bars of the Chroma Bar Sweep pattern should ideally be the same brightness and the color stripes in the 3.08 and 4.08 MHz bars should be equal intensity. As you reduce the chassis color level control all three bars should turn gray simultaneously.

The Luma/Chroma Bar sweep pattern is a combination of the Multiburst Bar Sweep and Chroma Bar Sweep patterns. An ideal video system will show good detail in the 2.28 MHz bar, and no color in the luminance bars.

APPENDIX C

MTS Theory Introduction

Commercial television broadcasting in the United States is based on NTSC standards. In the NTSC system each broadcast channel has a 6 MHz bandwidth. The video signal is broadcast as an AM signal 1.25 MHz above the lower channel boundary. The audio (aural) signal is an FM signal with a carrier located 4.5 MHz above the visual carrier. The monaural audio can produce a maximum instantaneous carrier deviation of 25 kHz and have a frequency response of from 50 Hz to 15 kHz. The audio also uses a 75 usec. pre-emphasis.

With the advent of FM stereo radio and the increased popularity of musical programming on television the need for a standard stereo signal format developed. One requirement of the new system was compatibility of the stereo signal with existing mono systems. The FCC adopted a Stereo TV signal format that is compatible with existing mono receivers and uses an advanced noise reduction system, developed by dBx, to solve some of the problems associated with stereo FM radio.

The MTS Signal

The signal format adopted for stereo television includes more than the stereo audio signal. It includes the mono channel, a stereo subchannel, a second audio channel, and a professional channel. Thus, the correct term for this system is Multichannel Television Sound (MTS). Figure D shows the makeup of the composite audio signal. This signal consists of the following:

Mono channel - The mono (L+R) channel is identical to the monaural signal used in the original NTSC format.

Stereo subchannel - The stereo (L-R) subchannel (sometimes called the difference channel) is similar to the stereo (L-R) subchannel use in FM stereo. In the MTS system, however, the (L-R) signal is processed by a noise reduction system before it is broadcast. To obtain the most efficient transfer of information this channel is broadcast as an amplitude modulated, suppressed carrier signal. The noise reduction system masks noise inherent in the FM signal.

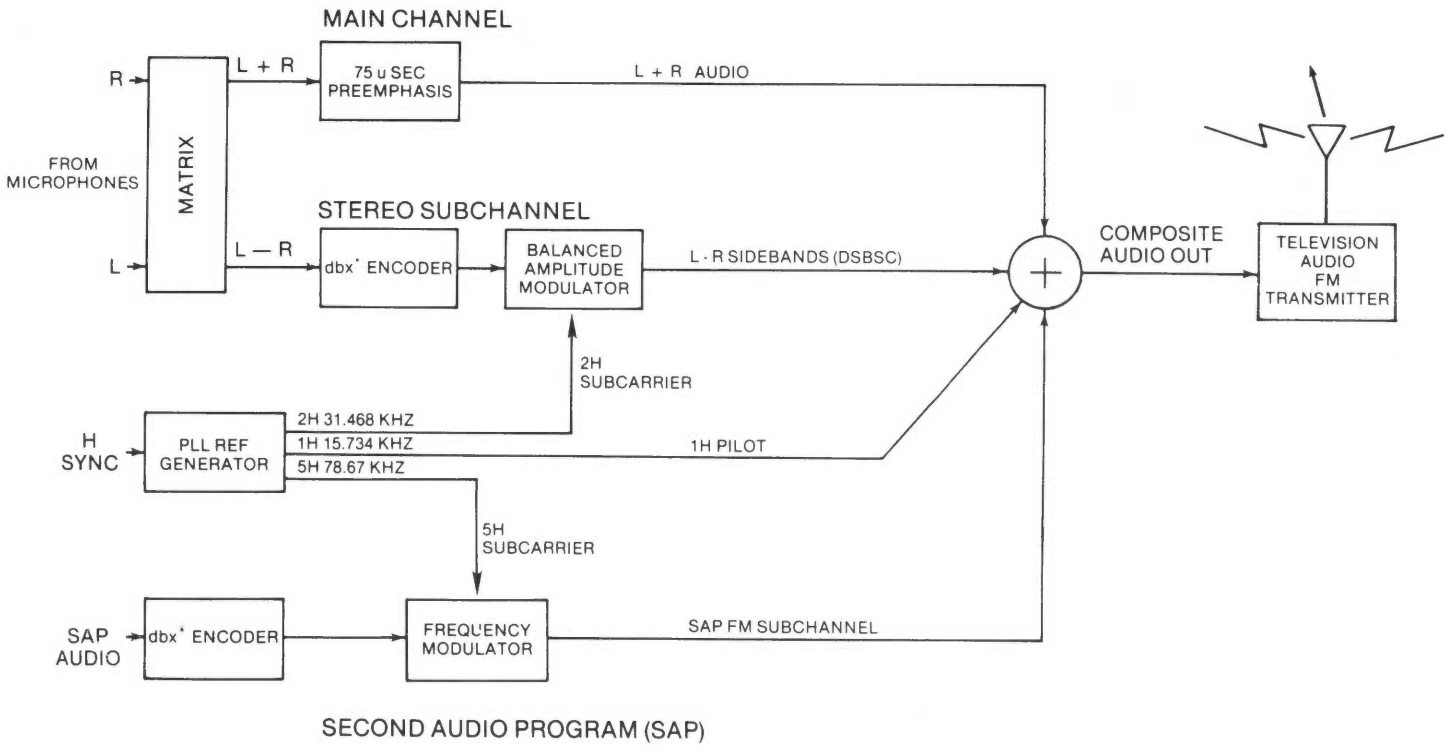


Fig. E - The makeup of the TMTS signal at the transmitter.

Pilot - The pilot signal at 15,734 Hz is used to tell the receiver that a stereo signal is present. It is also the reference for demodulating the (L-R) information.

Secondary Audio Program - This channel allows other audio, such as a second language, to be broadcast along with the stereo signal.

Professional Channel - This channel is included to transfer telemetry, such as information from remote television crews, back to the main production studios. It is not used to transmit broadcast information.

Generating the MTS Signal

In order to better understand how stereo TV works let's look at how the entire MTS signal is generated. Then we can see how it is converted back to the original audio information at the stereo TV receiver.

The main channel audio (L+R signal) is the sum of the left and right audio signals and occupies the same bandwidth as a monaural signal. All of the audio information is present in the main channel audio. This permits non-stereo receivers to obtain the full audio information. The main channel audio frequency modulates the aural carrier, and as in the original NTSC system, it also undergoes a 75 µsec. preemphasis.

The Stereo (L-R), subchannel, or the difference channel, is the difference between the left and the right audio information. The difference signal first goes through a noise reduction circuit. It is then processed by a balanced modulator using a 2H (31.468 kHz) subcarrier to produce a double-sideband suppressed-carrier (DSBSC) signal. Because the audio information is contained in the sidebands it is not necessary to transmit the carrier. Eliminating the carrier allows all the transmitter power to be used to transmit the information. At the receiver the carrier must be reinserted to demodulate the (L-R) information.

In order to properly demodulate the stereo (L-R) subchannel, a reference signal is needed that is phase locked to the original carrier. This reference signal is provided by the pilot signal. The pilot is a continuous sinewave signal at a frequency of 1H (15.734 kHz). The pilot does two things; it tells the receiver that a stereo signal is being broadcast, and it provides a phase reference to demodulate the stereo (L-R) subchannel. The 1H pilot signal, the 2H (L-R) carrier, and the 5H (SAP) carrier are all phase locked together by a PLL reference generator at the transmitter.

The secondary audio program channel (SAP) carries another audio program such as a second language. The SAP audio is sent through an identical noise reduction system as the stereo (L-R) subchannel. The signal is then frequency modulated using a 5H subcarrier.

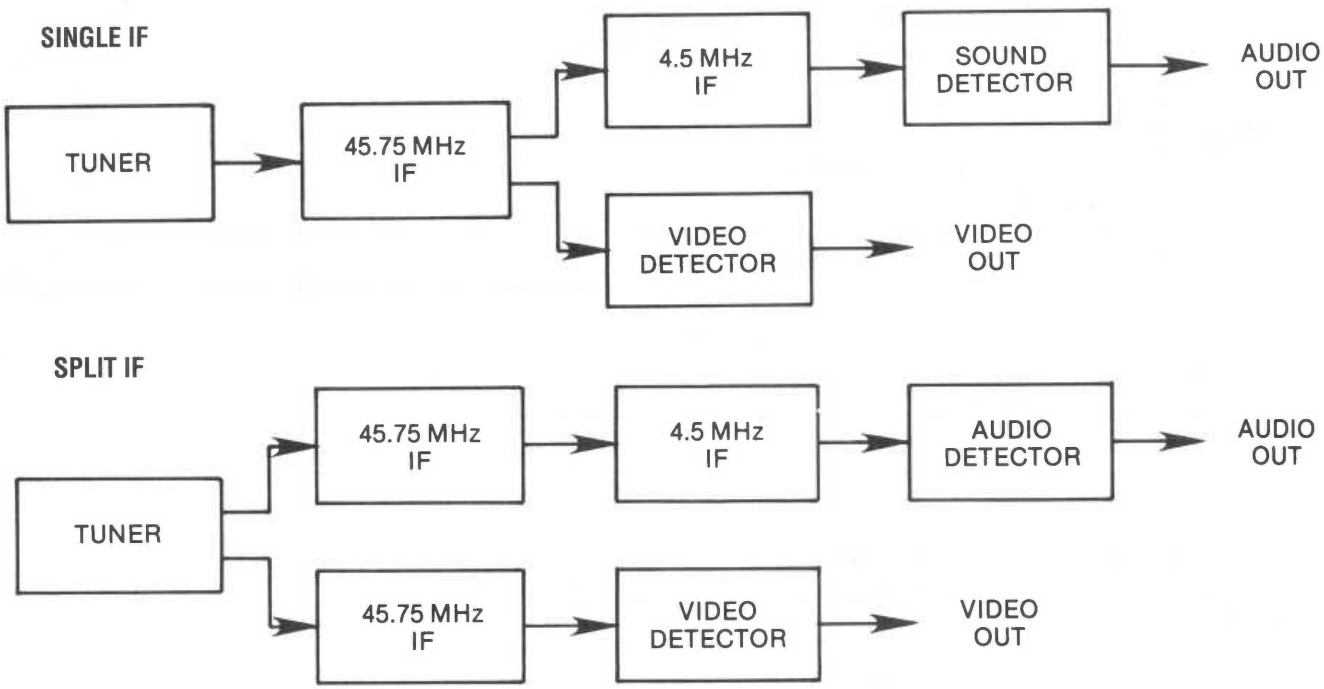


Fig. F - The IF section of a typical MTS receiver. Some MTS receivers use a "split IF" where the audio IF is passed by a separate 45.75 MHz IF.

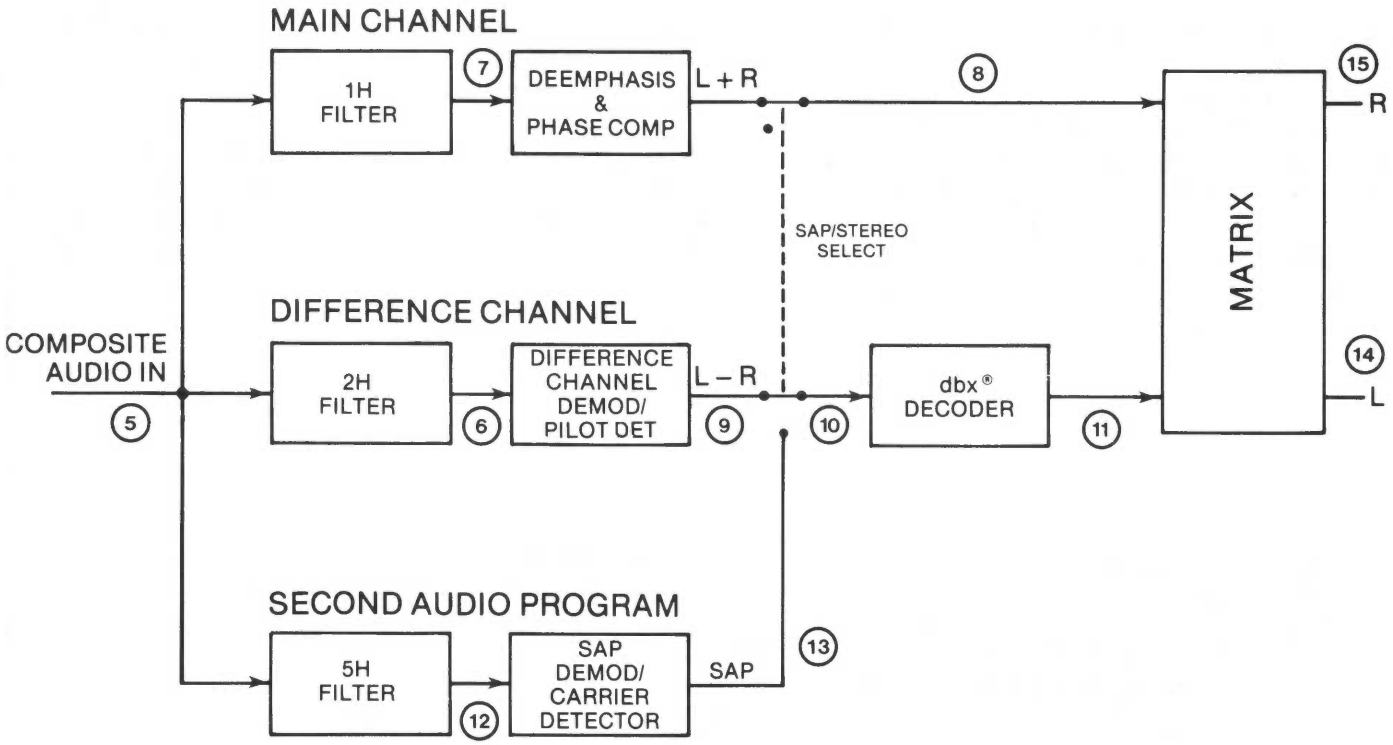


Fig. G - The MTS receiver processes the main channel, stereo channel and SAP channel signals separately.

Demodulating the Composite Audio Signal

In the receiver the modulated RF is converted to a 45.75 MHz IF signal by the tuner. Two different IF systems are used. In one system, the 45.75 MHz IF signal is sent through a single IF section. The aural signal is then converted into a 4.5 MHz signal as shown in Figure F. The other system is called split IF because a separate 45.75 MHz IF section is used for the aural signal, as shown in Figure F.

Once the IF signal has been converted to 4.5 MHz it is amplified and demodulated like it is in standard television sound systems. The output of the 4.5 MHz sound demodulator contains the audio baseband signal, called the composite audio signal. This signal includes the mono (L+R) channel, the stereo (L-R) subchannel, the stereo pilot, and the SAP channel.

The composite audio signal is separated into separate signal paths for processing as shown in Figure G . One signal path is through a 1H low pass filter. This filter passes only the 50 Hz to 15 kHz signal of the mono (L+R) channel. The mono signal is deemphasized and phase compensated before going on to the matrix. The deemphasis compensates for the preemphasis done at the transmitter. The phase compensation corrects the phase delay produced when the stereo (L-R) subchannel passes through the noise reduction circuits.

The composite audio signal also passes through a 2H bandpass filter. This filter passes the information contained in the L-R subchannel. The L-R subchannel signal is then sent to a balanced demodulator. An oscillator, phase locked to the stereo pilot, demodulates the L-R information. After demodulation the L-R signal is sent through a noise reduction circuit for processing and then to the matrix where it is combined with the L+R signal to obtain the original left channel and right channel audio.

A third path for the composite audio signal is through a 5H bandpass filter. This filter passes the Secondary Audio Program (SAP) information. The SAP signal is demodulated and sent on to the noise reduction circuits, stereo matrix, amplifiers, and speakers.

APPENDIX D

Vertical Interval Reference Signal (VIR)

Most television stations transmit a VIR signal during color broadcasts. The VIR signal allows VIR-capable receivers to provide consistent color reproduction. Video receivers that decode the VIR information automatically adjust the color tint and color level. This insures that the picture looks the same as the viewer changes channels, or if the reception quality changes. The station also uses the VIR signal. They constantly monitor it and use it to detect and correct any changes that occur in their video signal.

The VIR signal is on line 19 of the vertical blanking interval. It has three reference portions: 1) 3.58 MHz reference that has a peak-to-peak amplitude of 40 IRE units; 2) luminance reference level of 50 IRE units, and 3) black setup level of 7.5 IRE units.

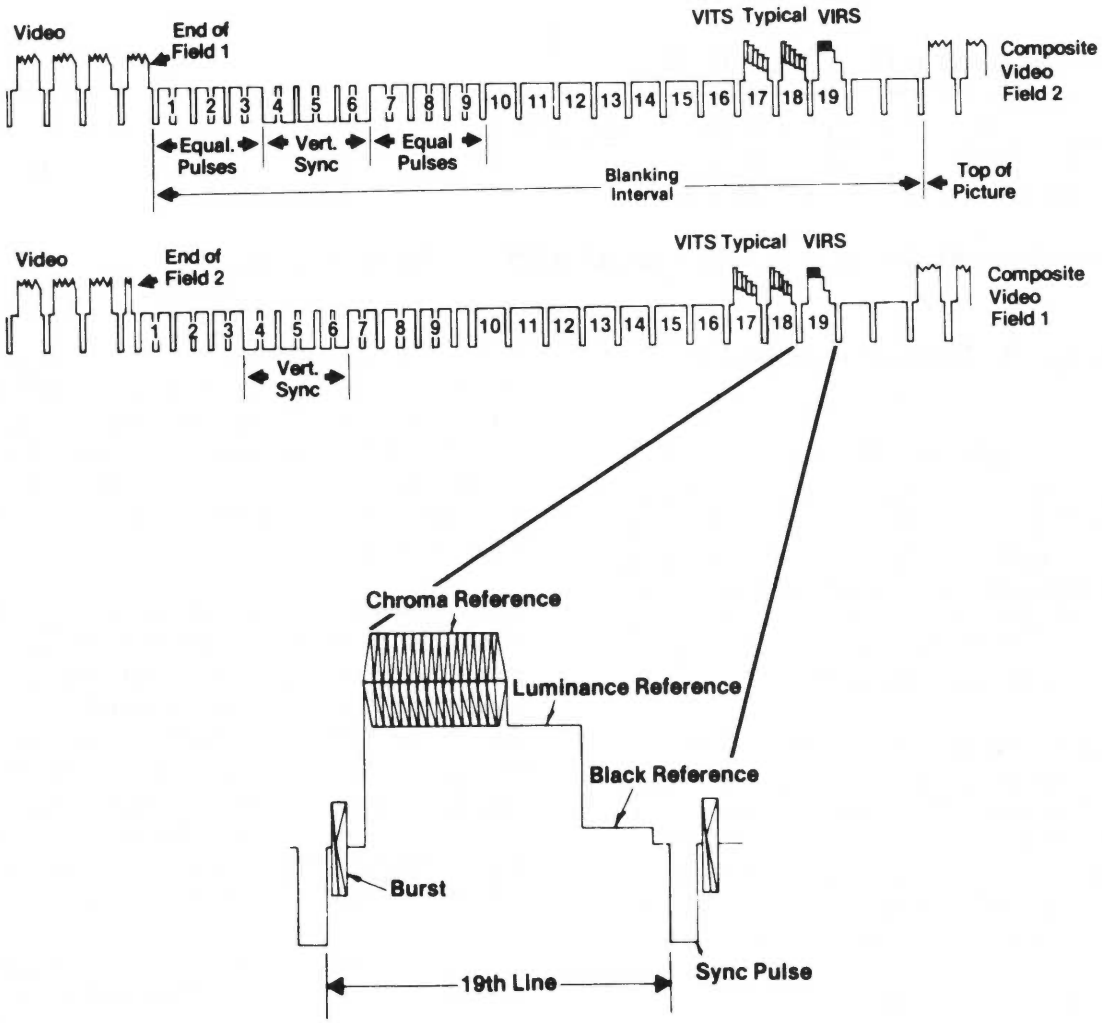


Fig. H - The VIR signal on line 19 provides a chroma and luminance reference.

APPENDIX E

Comb Filters

The comb filter allows the full bandwidth of luminance (Y) and chroma (C) signals in the video spectrum to be recovered. In the NTSC signal spectrum, the chroma and luminance information overlap at certain frequencies. This overlap is called interleave and is illustrated in Figure I.

The luminance and chroma signals must be separated and processed by different circuits to prevent picture interferences. The conventional method of separating the luminance information (Y) from the chroma information (C) is by of a bandpass filter. All the information from 0 to 3.0 MHz is allowed to pass to the luminance stages, while the signals from 3.08 MHz to 4.08 MHz are passed to the chroma circuits. With a bandpass filter all the luminance information in the overlapped area from just below 3.0 MHz to 3.08 MHz is lost (as is the chroma information).

A comb filter separates the interleaved luminance and chroma information using phase characteristics of the transmitted NTSC video signal. This results in extended luminance bandwidth, to near 4 MHz, and improved picture detail. A comb filter may also extend the chroma bandwidth to recover the wideband I color signal that extends 1.3 MHz below the 3.58 MHz color carrier. This results in better color detail.

In the NTSC signal, the chroma information is phased locked to the horizontal sync and changes phase 180 degrees each horizontal line. The comb filter separates the luminance and chroma information by delaying the composite video signal one horizontal line. The delayed video is then inverted and added back to the original video signal. This makes the phase of the delayed luminance the opposite of the original luminance and causes the luminance signals to cancel. The delayed and inverted chroma signal, however, is in phase with the non-delayed chroma signal and does not cancel. The result is the "combed" chroma output.

The luminance is recovered by inverting the combed chroma and adding it back to the original video. Now the chroma information is effectively cancelled leaving the luminance-only portion of the video signal.

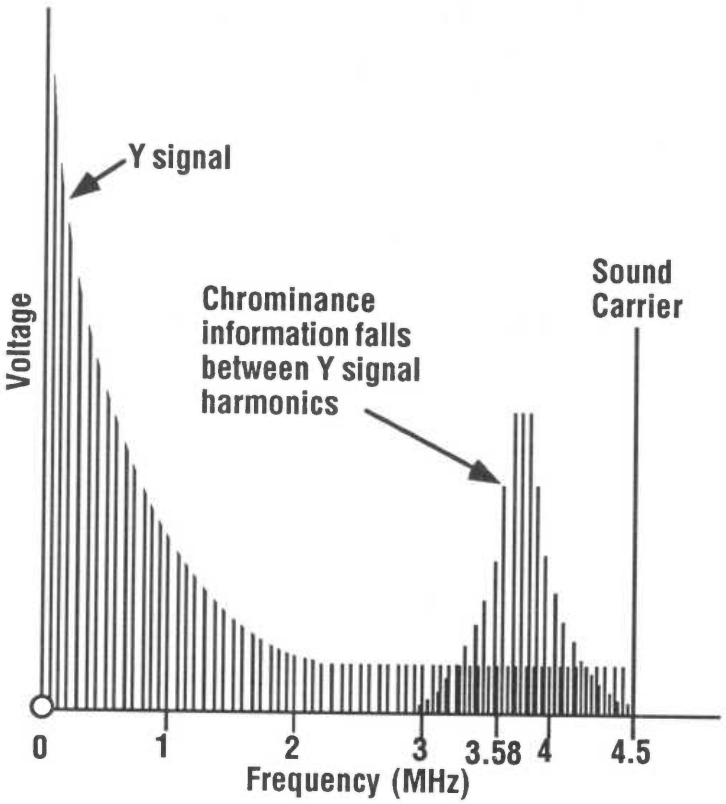


Fig. I - The luminance and chroma information are interleaved and share the same frequency spectrum in the composite NTSC video signal.

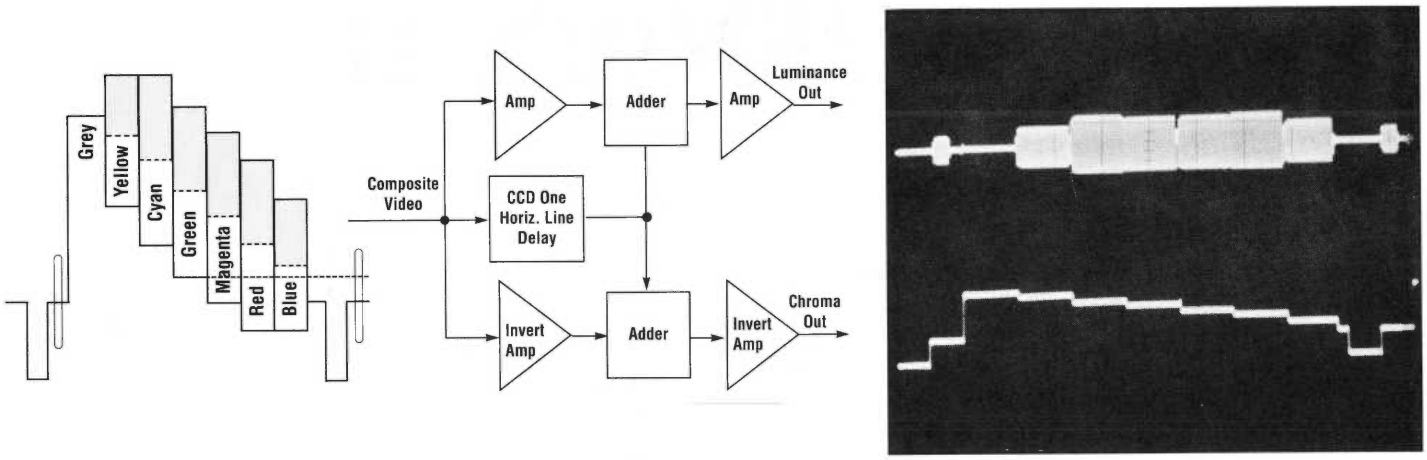


Fig. J - A comb filter separates the interleaved luminance and chroma signals to improve signal bandwidths.

GLOSSARY

ACC - Automatic Color Control. Used to maintain constant color signal levels.

ACK - Automatic Color Killer. Turns off the color circuits if the 3.58 MHz color burst is missing.

AFT - Automatic Fine Tuning. Adjusts the local oscillator to maintain the video IF carrier at 45.75 MHz.

AGC - Automatic Gain Control. Adjusts the gain of the RF amplifier and sometimes the first video IF amplifier to compensate for RF signal variations. Maintains constant amplitude signal at the video detector output.

Bandwidth - The highest frequency that the video circuits can pass.

Black Level - The video signal level that corresponds to the maximum limits of the black area of a picture.

Blanking Level - The video signal level that separates the picture information from the sync information

Burst Gate - A circuit that is keyed to conduct during the time of the color burst.

Chroma - The color portion of a video signal, also called the C signal. It contains hue (phase angle) and saturation (amplitude) information of the color, but contains no brightness or luminance information.

Color Burst - An 8-10 cycle reference of the 3.58 MHz color subcarrier that occurs right after the horizontal sync pulse. Used as the reference for phase comparison to keep the color oscillator locked to the broadcast signal. Also references the ACC and ACK circuits.

Color Subcarrier - A 3.579545 MHz signal that is modulated to produce the color sidebands that carry the color information. It is suppressed during transmission.

Color Tracking - Same as gray scale tracking. Ability to produce a B&W picture on a color CRT over the entire contrast and brightness range with no signs of color tint.

Comb Filter - An electronic circuit that has a pass response that resembles a comb. Separates the video luminance from the color based on their phase relationship.

Composite Sync - Signal that contains vertical and horizontal sync information.

Composite Video - Signal consisting of luminance, chroma, color burst, composite sync pulses and blanking pulses. The luminance and chroma signals are interleaved.

Contrast - Range of light to dark values in a picture. A control the adjusts the gain of the video amplifiers.

Deemphasis - The process of attenuating previously amplified signals to reproduce the original signal. Part of a noise masking scheme.

Demodulator - Device that removes the intelligence from a modulated carrier.

EIA - Electronic Industries Association.

Gray Scale - Video pattern of evenly-spaced steps from dark (black) to bright (white).

Gray Scale Tracking - Same as color tracking.

Horizontal Blanking - The time after each horizontal scan line when the electron beam is turned off.

Horizontal Frequency - The rate at which the electron beam makes one scanning cycle across the screen from left to right and back.

Horizontal Retrace - The time during which the electron beam returns from the right side of the CRT to the left side.

Hue - Also called tint. The distinction between colors, or the color itself, ie: red, green, blue.

Interlace - NTSC video scanning method where the raster has two fields of horizontal scan lines. The odd lines are scanned in the 1st field and the even lines are scanned in the second field.

Interleave - The process that allows the luminance and chroma signals to occupy the same frequency spectrum in the NTSC video signal. This is a result of the luminance and chroma information being phase-locked to different multiples of the horizontal scan frequency.

Luminance - The black and white only portion of the video signal, also called the "Y" signal. It produces the bright and dark portions of the picture.

Monitor - A video display device that accepts a composite video and/or a Y/C signal. It often does not contain a tuner.

Noise - Electrical interference that produces "snow" on the screen. Noise is often produced by the mixer stage in the tuner.

Non-Interlace - A scanning method consisting of 2 fields of horizontal scan lines. The lines from field 2 are scanned directly on top of the lines from field 1.

NTSC - National Television System Committee. Standards that define the present video telecast system used in the US and Canada.

Raster - The area of brightness that occurs on the CRT screen as a result of vertical and horizontal scanning.

Resolution - The maximum number of distinct dark-to-light transitions visible on the screen. Dependant on the frequency response of the video circuits.

Separation - The difference in signal levels between left and right audio channels, or between the luminance and chroma channels.

Vectorscope - Instrument that separates the chroma information from the composite video signal and graphically displays the color amplitude and phase.

Vertical Blanking - The time after the downward beam movement (field) when the electron beam is turned off.

Vertical Frequency - The rate at which the electron beam makes one scanning cycle from the top of the screen to the bottom of the screen and back.

Vertical Retrace - The time during which the electron beam returns from the bottom of the CRT to the top.

VIR - Vertical Interval Reference. Has 3.58 MHz reference, luminance reference and black setup level. Located on line 19

White balance - Adjusting the red, green and blue guns of a CRT to produce white.

Y - Abbreviation for luminance signal.

Y/C - An input or output connector that provides the luminance (Y) signal and chroma (C) signals separately.

WARRANTY

Your Sencore VG91 "Universal Video Generator" has been built to the highest quality standards in the industry. Each unit has been tested, aged under power for at least 24 hours, then, every function and range was retested to insure it met all published specifications after aging. Your instrument is fully protected with a 1 year warranty and Sencore's exclusive 100% Made Right Lifetime Guarantee in the unlikely event a defect was missed. Details are covered in a separate document included with your instrument.

SERVICE

The Sencore Factory Service Department provides all in and out-of-warranty service and complete recalibration services for Sencore instruments. No local service centers are authorized to repair Sencore Instruments. Factory service assures you of the highest quality work, the latest circuit improvements and the fastest turnaround time possible. Most service repairs are completed within 72 hours of receipt.

Repacking For Shipment

Save the original shipping carton and packing material for reuse should you ever need to ship your VG91, or return it to the Sencore factory for repair. If the original materials are unavailable or unfit for reuse, repack the VG91 according to the following guidelines:

1. Use a corrugated cardboard shipping container that has a test strength of 100 lbs. and inside dimensions of at least 10" x 17" x 20" (HWD).

2. Enclose the following information: Owners address, billing information, purchase order (if applicable), name and phone number of contact person, description of problem and reason for return. No return authorization is required.

3. Enclose the unit inside a plastic bag to protect its finish and prevent foreign material from getting inside.

4. Cushion the unit equally on all sides with a minimum of 3 inches of padding material. Pack the padding tightly enough to prevent the unit from shifting during shipment.

5. Seal all seams on the container with strapping tape.

6. Send the packed unit to address listed below (we recommend shipping via United Parcel Service).

A separate schematic and parts list is included should you want to repair your own instrument. Parts may be ordered directly from the Service Department. Any parts not shown in the parts list may be ordered by description.

We reserve the right to examine defective components before an in-warranty replacement is issued.

SENCORE FACTORY SERVICE
3200 Sencore Drive
Sioux Falls, SD 57107
Toll Free: 1-800-SENCORE
FAX (605) 335-6379

Fill in for your records:

Purchase Date:_____ Serial Number: _____ Run Number:_____ ___

NOTE: Please refer to the run number if it is necessary to call the Sencore Factory Service Department. The run number may be updated when the unit is serviced.

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